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Chemical Week

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May 30, 1959

North American's new MARK-20
20,000 gallons in one load!

Here is the car railroads have been waiting for to compete better with other forms of transportation. The MARK-20 offers shippers economies in leasing rates, demurrage costs, and handling charges. The MARK-20 offers the railroads lower operating costs and in turn advantage can be taken of incentive rates with higher minimums.

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The MARK-20—approx. 180,000 lbs.

8,000 gallon tank car—approx. 90,000 lbs.

Highway truck maximum—approx. 45,000 lbs.

North American Car will custom build the MARK-20 to shipper's specifications. The car can be insulated, coiled, or compartmentalized. It is domeless for greater strength and can withstand pressure of 100 lbs. per square inch compared with 60 lbs. of most other tank cars.

Other Features of the
MARK-20

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- Top unloading device
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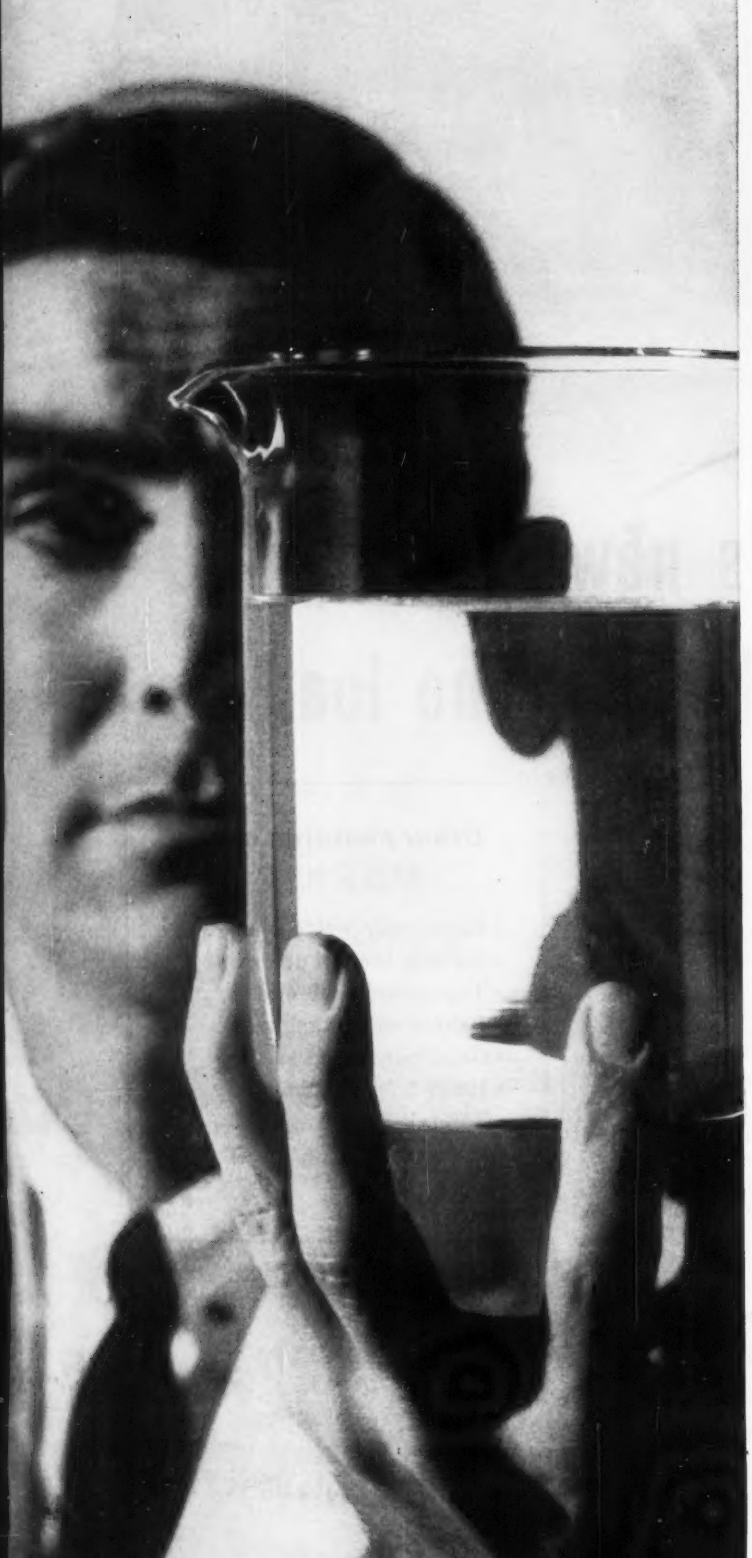
Shippers! Here is the way to reduce your distribution costs and restore traffic to the rails

IMPROVE COLOR IN PROPIONATE SALTS AND ESTERS

with CARBIDE'S Propionic Acid



Complete analysis shows CARBIDE's propionic acid is high in purity, has a narrow boiling range, and is essentially free from contamination with other organic acids. This quality means you can improve color and cut unwanted odor by preparing propionate salts and esters using CARBIDE's propionic acid.

Confirm this quality for yourself by comparing these specifications:

Specific Gravity at 20/20°C.	.993 to .997
Distillation Range at 760 mm Hg	
Ibp	138.5°C. min.
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Heavy Metals, as Lead	5 ppm, max.
Water	0.15% by wt., max.
Non-volatile Matter	0.01% by wt., max.
Color	15 Pt-Co, max.
Suspended Matter	Substantially free
Aldehydes, as Propionaldehyde	0.05% by wt., max.
Oxidizable Substance, as Formic Acid	0.05% by wt., max.

CARBIDE's propionic acid is used as a feed additive and as a raw material for mold inhibitors, pharmaceuticals, herbicides, perfumes, and flavors. For further information on physical properties and a summary of uses, call your CARBIDE Technical Representative or send for a copy of the technical information bulletin on propionic acid. Write, Department M, Union Carbide Chemicals Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, New York.

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Chemical Week

TOP OF THE WEEK

MAY 30, 1959

COVER COURTESY STANDARD OIL CO. OF CALIFORNIA

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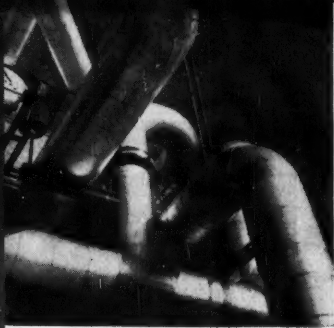

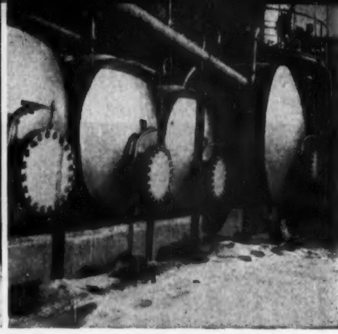

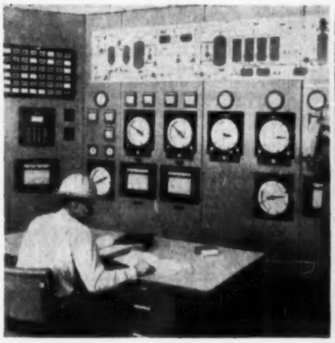

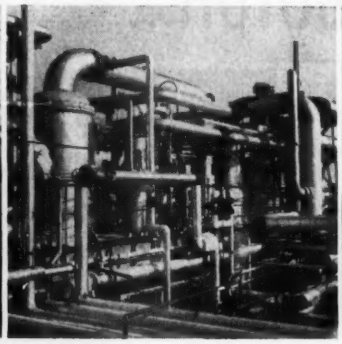

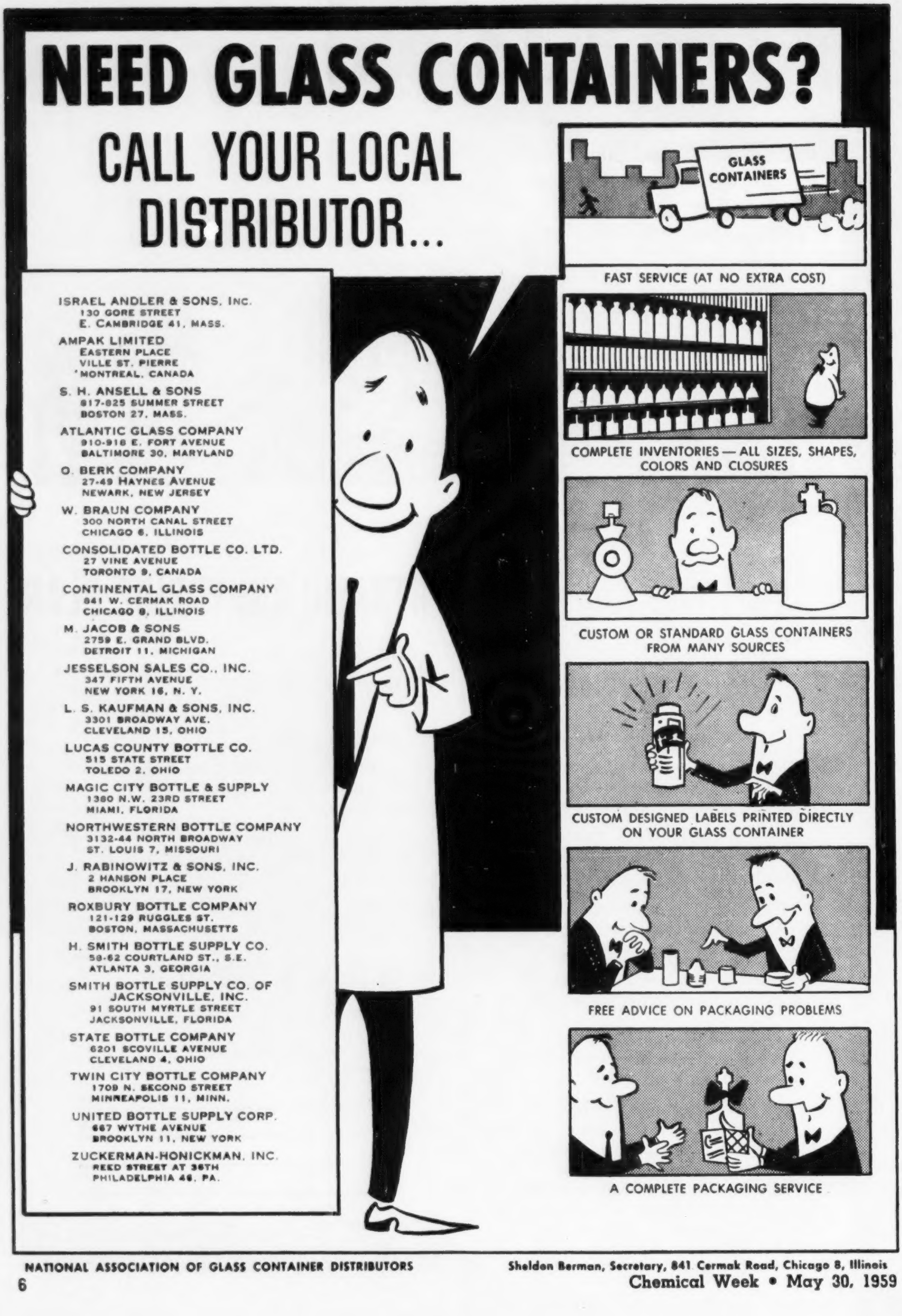
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- Reaction medium and solvent
- Dyeing assistant

acetic anhydride
- Acetylating agent
- Dehydrating agent in nitration and sulfonation reactions, etc.

propionic acid
- Ca or Na salt used as bread mold inhibitor
- Raw materials for herbicides

propionic anhydride
- Acylating agent
- Intermediate

n-butyric acid
- For the preparation of butyric esters useful in formulating perfumes and flavorings

n-butyric anhydride
- Acylating agent
- Intermediate

isobutyric acid
- As a starting point for the synthesis of plasticizers, perfume materials and lacquer solvents

isobutyric anhydride
- For the preparation of aromatic esters for perfumes

2-ethyl hexoic acid
- Pb, Mn and Co salts are used as oil paint driers
- Zn and Na salts are used as emulsifying and dispersing agents

For properties and shipping information on these and other Eastman products, see **Chemical Materials Catalog,** page 357 or **Chemical Week Buyers Guide,** page 85.

Whether you buy by the drum or tank car, you can depend on the uniformly high quality of Eastman acids and anhydrides to simplify the control of your processing operations. For more information, samples and specifications, write to our nearest sales office.

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See why ALCOA ALUMINUM makes a good design habit

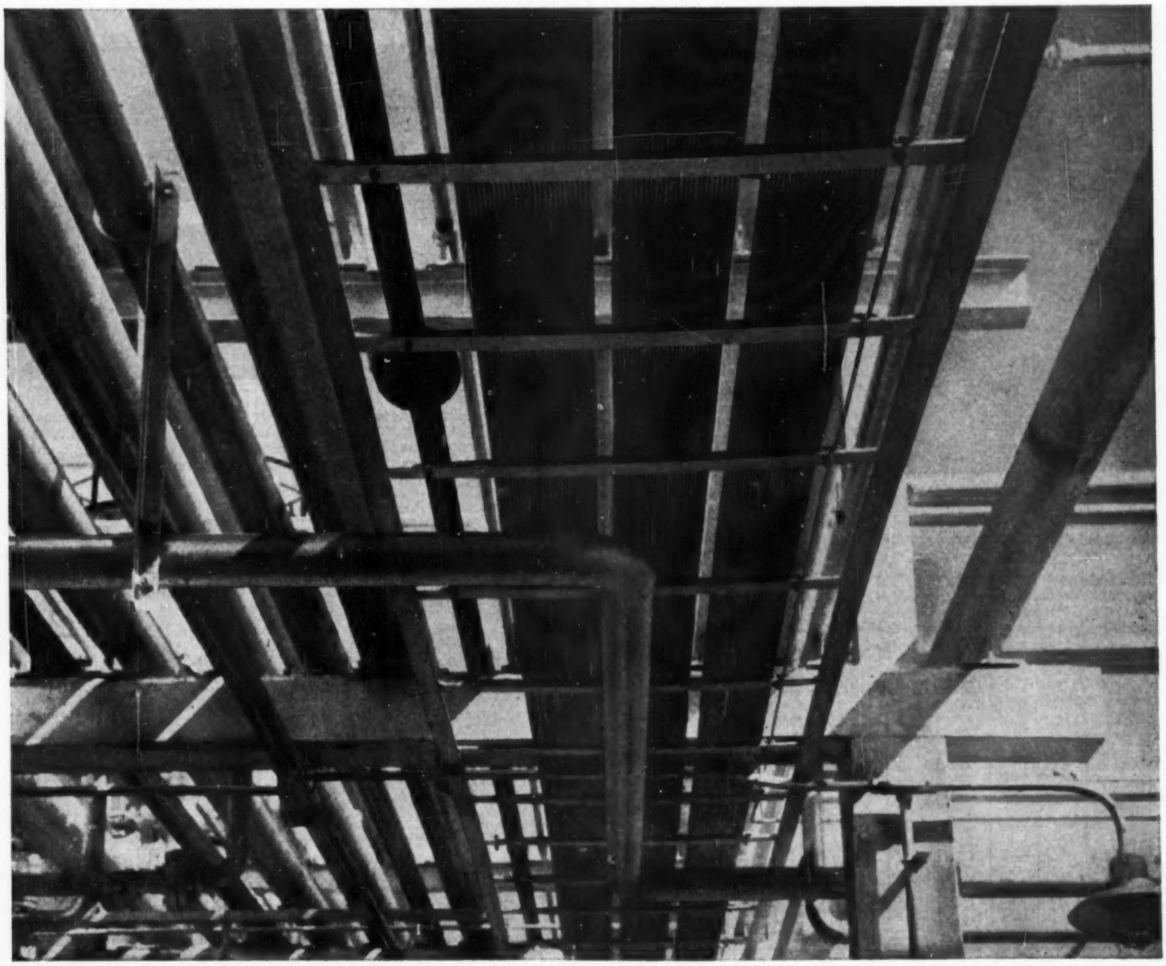
Requirement: low-cost, high-strength, corrosion-resistant process pipe and tubing

Key to good design: specify tubular products of Alcoa Aluminum

Metal tube or pipe is perhaps the most common material to be found in chemical and petroleum processes. It carries process liquids and gases through each stage of production. It serves in instrumentation lines, relaying information between controls and valves. It is the heart of heat exchangers and other processing equipment. Specify ALCOA® Aluminum Pipe and Tube to do all these jobs safely and economically.

ALCOA aluminum tubular products have a long record of reliability in process applications. No other pipe or tube matches their resistance to corrosion from such a wide range of chemicals and petroleum products. No other metal approaches their low cost and freedom from maintenance. No other tube or pipe combines these features with long life, high strength, and the physical properties required by so many processors.

These pages show you just a few of the applications where ALCOA aluminum tubular products are at work fighting corrosion and providing substantial economies. There is an area in your process where aluminum can help cut costs and improve efficiency. ALCOA makes aluminum pipe and tube in a number of standard alloys and in a wide variety of sizes ideally suited to chemical and petroleum processing.



Piping

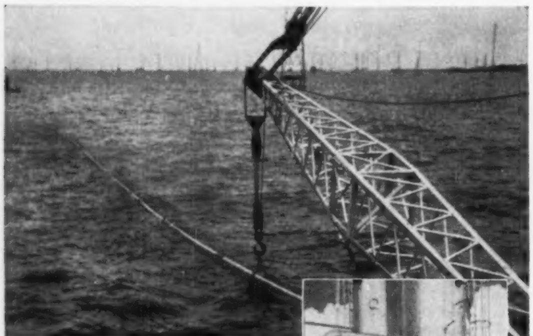
Where product protection, corrosion resistance and strength are primary considerations for piping, aluminum is your best answer, and is often the least expensive.

ALCOA Aluminum Piping resists attack by materials within the pipe, as well as by corrosive environments outside. It does not catalyze the decomposition of many sensitive chemicals as other metals do.

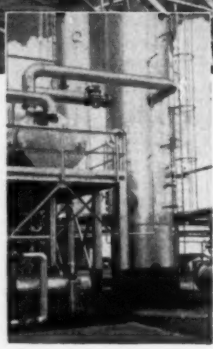
With ALCOA Aluminum Pipe you also get a smooth, low-friction surface, high thermal conductivity and nonsparking characteristics . . . all highly desirable qualities.

In ultra-low temperature applications ALCOA Aluminum Piping retains its excellent physical properties without embrittlement. Tests to as low as minus 423 degrees F show it actually increases in strength as the temperature drops. That's why aluminum is specified for tonnage oxygen and other cryogenic applications.

ALCOA Aluminum Pipe is produced in ASA sizes from ⅛ in. through 12 in., and in a variety of alloys and tempers, some with the strength of low carbon steel. Seamless pipe in sizes up to 20 in. in diameter is available.



A welded section of 4-in. Alcoa Aluminum Pipe is lowered into Lake Maracaibo, Venezuela, for the world's first permanent aluminum underwater oil pipeline. It replaces a steel pipeline that failed from the corrosive effects of the lake's brackish waters. The line connects an underwater well to a flow station.



Because aluminum piping does not discolor or contaminate the product, it is used at this organic chemicals plant to handle chemicals for the production of synthetic fibers.

BURSTING PRESSURES Pipe—not welded

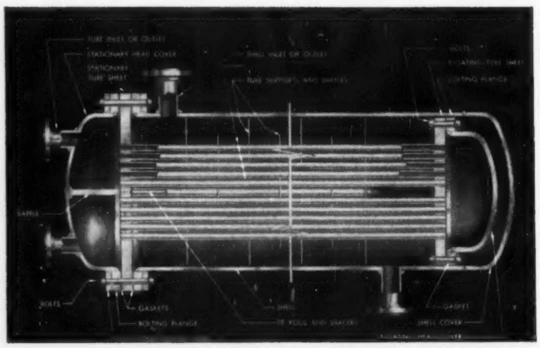
Nominal Pipe Size, Inches	Schedule Number	BURSTING PRESSURE, PSI 3003-H112①	6063-T6	6061-T6	Nominal Pipe Size, Inches	Schedule Number	BURSTING PRESSURE, PSI 3003-H112①	6063-T6	6061-T6
⅛	40	......	11,900	15,020	2½	5	......	1,810	......
¼	40	......	11,490	14,490	2½	10	......	2,650	......
⅜	40	......	9,270	11,730	2½	40	1,790	4,590	5,820
½	40	......	8,880	11,220	3	5	......	1,480	......
¾	10	......	5,180	......	3	10	......	2,160	......
¾	40	......	7,220	9,130	3	40	1,550	3,980	5,050
1	5	......	3,160	......	3½	40	1,420	3,630	4,600
1	10	......	5,450	......	4	5	......	1,150	......
1	40	2,630	6,750	8,560	4	10	......	1,670	......
1¼	5	......	2,480	......	4	40	1,320	3,370	4,280
1¼	10	......	4,250	......	5	40	1,150	2,950	3,750
1¼	40	2,160	5,550	7,030	6	5	......	1,160	......
1½	5	......	2,160	......	6	40	1,050	2,680	3,410
1½	10	......	3,690	......	8 (.277)	30	790	2,020	2,560
1½	40	1,940	4,990	6,320	8 (.322)	40	920	2,360	2,990
2	5	......	1,720	......	10 (.279)	...	630	1,630	2,070
2	10	......	2,920	......	10 (.307)	30	700	1,790	2,280
2	40	1,630	4,190	5,320	10 (.365)	40	835	2,140	2,720
					12 (.375)	...	720	1,850	2,340

Computed bursting and yielding pressures and conversion factors for 3003-H112 alloy also apply to 3003-F alloy. They are based on the properties of the 3003-O alloy.

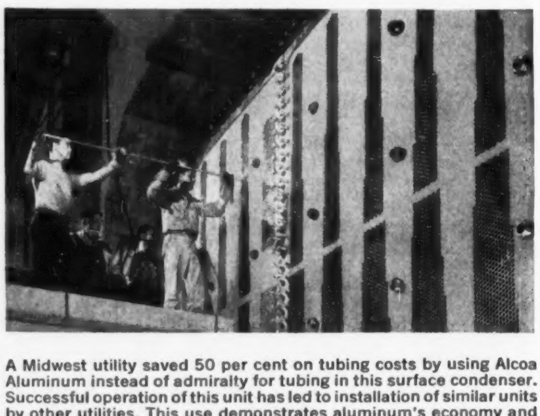
Heat exchanger tubing

Corrosion resistance, long life, product purity, high thermal conductivity and economy . . . all these vital requirements in heat exchanger design are satisfied when you specify ALCOA Aluminum Tubing. The petroleum industry uses aluminum in main column overhead condensers where its freedom from fouling and excellent heat transfer properties have made it a natural selection. Heat exchangers with ALCOA Aluminum Tubing also are used in the chemical process industry. Prime examples are for the production of ammonia, nitric acid, vegetable oils, naval stores, naphthalene, hydrogen peroxide, oxygen and urea. These and other processes call for heat exchanger tubing with high strength, excellent sub-zero physical properties, high thermal conductivity, or nontoxicity and noncatalytic properties. Any one or a combination of these requirements can be met efficiently and economically with ALCOA Aluminum Tubing.

ALCOA Aluminum is the least expensive tube available. In the common sizes it costs one-third less than mild steel, one-half as much as admiralty, and only one-fifth as much as stainless.



For certain processes where corrosive or sensitive materials are involved it is often advisable to use aluminum for entire heat exchanger systems to avoid system corrosion and contamination of the product. A typical heat exchanger is shown here. Alloy recommendations are given in "Alcoa Aluminum Heat Exchanger Tubes."



A Midwest utility saved 50 per cent on tubing costs by using Alcoa Aluminum instead of admiralty for tubing in this surface condenser. Successful operation of this unit has led to installation of similar units by other utilities. This use demonstrates aluminum's economy and superior resistance to ammonia, carbon dioxide and hydrogen sulfide.

See why ALCOA ALUMINUM makes a good design habit

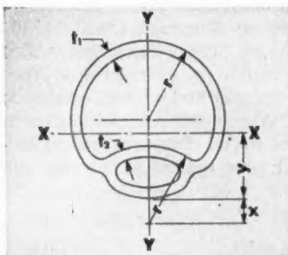
Unitrace the aluminum process pipe with integral steam tracing

ALCOA® Unitrace solves the problem of applying heat to a product during processing. With Unitrace you get standard pipe OD with an integral steam passage located adjacent to the product passage . . . eliminating the labor and cost involved in installing external steam jackets or steam tracer tubes.

Extruded as a single unit of ALCOA 6063-T5 aluminum alloy, Unitrace has aluminum's natural corrosion resistance, making it ideal for transferring molten sulfur, ammonium nitrate solutions, glacial acetic acid, fatty acids, naphthalene, phthalic anhydride, urea, wax, tar products, and numerous other products which must remain liquid during transfer.

ALCOA continues to be the leader in supplying various sizes of this type of pipe. You can get Unitrace in pipe sizes from 1 in. through 8 in.

Because Unitrace is completely compatible with other piping systems, it provides an unusual degree of design flexibility in process systems. Special Unitrace flanges, trace-caps, elbows and adapter flanges, cast of ALCOA A356-T7 aluminum alloy, are available from ALCOA.



	Unitrace Sizes	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
Axis XX	Moment of Inertia (I) $in.^4$	.09	.34	.72	2.71	6.52	31.82	81.82
	Radius of Gyration (R) in.	.37	.58	.72	1.09	1.42	2.12	2.78
	Section Modulus (S) $in.^3$	.13	.34	.56	1.42	2.65	8.73	17.22
Axis YY	Moment of Inertia (I) $in.^4$	.09	.33	.70	2.65	6.36	29.72	76.70
	Radius of Gyration (R) in.	.37	.57	.71	1.08	1.40	2.05	2.69
	Section Modulus (S) $in.^3$	.14	.34	.59	1.52	2.83	8.97	17.79

Sizes	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
r	.657	.950	1.187	1.750	2.250	3.312	4.312
t_1	.133	.145	.154	.170	.187	.280	.322
t_2	.145	.163	.174	.185	.200	.307	.354
x	.133	.344	.406	.625	.813	1.500	2.000
y	.61	.87	1.08	1.59	2.03	2.98	3.87

Average coefficient of thermal expansion (per °F)	−58 to +68°F	68 to 212°F	68 to 392°F	68 to 572°F
	12.1×10^{-6}	13.0×10^{-6}	13.6×10^{-6}	14.2×10^{-6}

Temp. °F	Pressure psi	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
Up to 100°F	Bursting Pressure of Product Line	2980	2265	1925	1425	1210	1210	1085
	*Pressure Differential	2240	1700	1445	1070	910	910	815
	Bursting Pressure of Trace Line	2980	2265	1925	1425	1210	1210	1085
200°F	Bursting Pressure of Product Line	2800	2130	1810	1340	1140	1140	1020
	*Pressure Differential	2100	1600	1360	1005	855	855	765
	Bursting Pressure of Trace Line	2800	2130	1810	1340	1140	1140	1020
300°F	Bursting Pressure of Product Line	2530	1920	1630	1210	1030	1030	925
	*Pressure Differential	1860	1410	1200	900	755	755	675
	Bursting Pressure of Trace Line	2530	1920	1630	1210	1030	1030	925
400°F	Bursting Pressure of Product Line	1340	1020	865	650	545	545	490
	*Pressure Differential	670	510	435	320	275	275	245
	Bursting Pressure of Trace Line	1340	1020	865	650	545	545	490

*The pressure in the product line should not exceed the pressure in the trace by more than this amount.
Note: Bursting pressure data based on tests with welded Unitrace flanges and minimum mechanical properties.

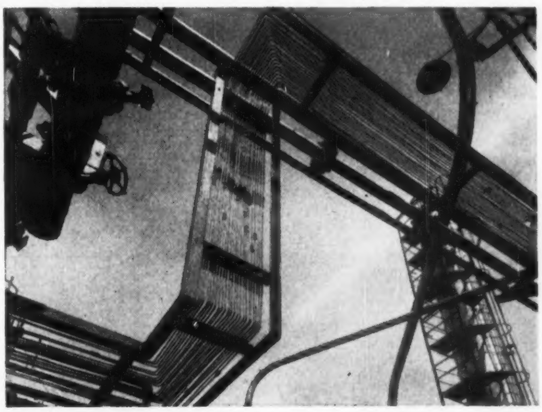
Utilitube for instrument, hydraulic, fuel and lubricating lines

Utilitube is a low-cost coiled tube made of 5050 aluminum alloy. Literally millions of feet of it have been installed for the above applications. For these and other uses Utilitube provides outstanding economy along with such desirable physical properties as corrosion resistance, freedom from gum or sludge formation, high fatigue strength, good bursting strength and easy workability.

Utilitube can be supplied in economical, long lengths up to 1,000 feet or more. It weighs only one-third as much as copper tubing of similar capacity and costs up to 40 per cent less.

Utilitube can be joined by all common methods. Standard compression-type or flare-type fittings may be used. Utilitube can be flared easily, using conventional tools and practices. Installation methods are similar to those used with other types of tubing.

Gas and oil processing plants use large quantities of Alcoa Utilitube for instrument air lines. The corrosive atmospheres of hydrogen sulfide and sulfur dioxide in these areas have no effect on Utilitube. In addition to its resistance to corrosion, Utilitube has superior physical properties at sub-zero temperatures. That's why more and more of it is being used for cryogenic processes. In this application, its physical properties actually improve as the temperature drops.



BURSTING PRESSURES AND WEIGHTS PER FOOT OF TYPICAL SIZES OF ALCOA UTILITUBE①

Computed Bursting Pressures based on minimum properties at operating temperatures not exceeding 100°F.

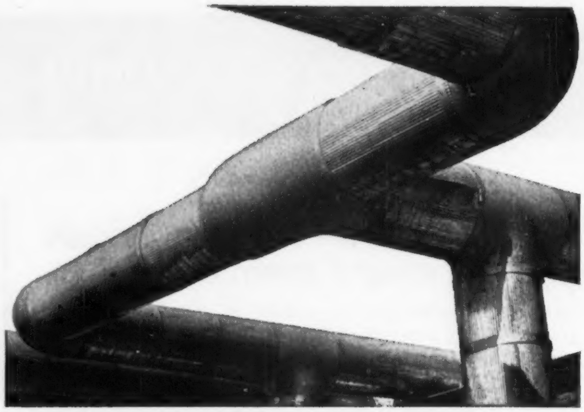
OD, in.	Wall Thickness in.	Computed Bursting Strength②, psi	Weight per Foot③, lb
⅛	0.025	7380	0.0091
3/16	0.028	5260	0.0163
¼	0.032	4420	0.0255
5/16	0.035	3810	0.0355
⅜	0.049	4520	0.0584
⅜	0.035	3130	0.0435
½	0.049	3300	0.0808
½	0.035	2300	0.0595
⅝	0.049	2590	0.1032
¾	0.058	2550	0.1468

① B50S-O

② $P=KS\frac{2t}{D-0.8t}$ in which S=18,000 psi specified minimum longitudinal tensile strength, D=nominal outside diameter in inches, t=nominal thickness in inches, and K is a factor dependent on yield-tensile strength ratio (K=0.86 for B50S-O).

③ Based on 0.097 lb per cu in., from "Alcoa Aluminum and Its Alloys," 1950, page 108, Table 13.

Pipe jacketing



Pipe jacketing made with ALCOA Aluminum Foil or sheet protects insulated process pipes both indoors and outdoors. In many cases it actually costs less to cover pipes with this material than it does to paint them. Aluminum pipe jacketing has required no maintenance for as long as 10 years in some applications. This jacketing resists corrosion and can be used with a moisture barrier over any type of insulation. It is available with or without a moisture barrier attached.

Aluminum jacketing is easy to cut and handle, and can be installed quickly and easily without special tools or skills.

UNISTRENGTH Pipe newest tubular product of Alcoa Aluminum

ALCOA developed this new type of aluminum pipe to make possible welded lines with uniform bending, bursting and tensile strength throughout. The secret of UNISTRENGTH is a reduction in wall thickness everywhere but at the ends where it is needed for joining. This compensates for the local reduction in strength caused by the heat of welding on popular heat-treatable pipe alloys. Result: ALCOA eliminates unneeded metal (up to 40 per cent) to provide a uniformly strong piping system with important savings in weight and cost.

ALCOA ENGINEERS have worked closely with all segments of the process industries for over 40 years, and can help you specify the aluminum tubular product best suited for your process application. ALCOA's unparalleled experience in this field is available to you for the asking. Write to the address below, stating your requirements as specifically as possible. ALCOA's development engineers will welcome the opportunity to work with you on your problems.

You can also take advantage of the wide selection of free ALCOA literature on aluminum tubular products and other process applications. Simply check the booklets you want on the coupon and mail to the address below. ALCOA will forward your material promptly and without obligation.

During 1959, ALCOA will conduct engineering conferences in a number of major cities on process industries uses of aluminum. Call your nearest ALCOA sales office for details.

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Please send me the following literature covering Alcoa Aluminum for tubular products and other uses in the process industries:

- ☐ 10197 Aluminum Pipe and Fittings
- ☐ 34-10418 Alcoa Unitrace: Combines Piping and Tracing in One Unit
- ☐ 10186 Alcoa Aluminum Heat Exchanger Tubes
- ☐ 10270 Alcoa Utilitube
- ☐ GL88C Aluminum Pipe for Aircraft Fuel
- ☐ 10460 Process Industries Applications of Alcoa Aluminum
- ☐ 10508 Cleaning and Maintenance
- ☐ 20849 Resistance of Aluminum Alloys to Weathering and Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres
- ☐ 20265 Have You Tried Aluminum in Your Refinery?
- ☐ 20935 Designing to Prevent Corrosion
- ☐ GL86C Unfired Pressure Vessels of Aluminum Alloys
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- ☐ 20437 Aluminum Alloy Heat Exchangers in the Process Industries
- ☐ DD508 Aluminum Alloys in Tank Trucks and Tank Trailers
- ☐ 10387 Alcoa Standard Storage Tanks
- ☐ 20272 Aluminum Alloys for Handling High Purity Water
- ☐ 20268 Resistance of Aluminum Alloys to Fresh Waters
- ☐ 10130 Forming Alcoa Aluminum
- ☐ 10416 Brazing Alcoa Aluminum
- ☐ 10415 Welding Alcoa Aluminum
- ☐ 10051 Alcoa Aluminum Handbook

Name____________________

Company____________________

Title____________________

Address____________________

City____________________

State____________________

OPINION

Lube Kudos

To The Editor: . . . I enjoyed reading your informative article on synthetic lubricants *(CW, April 4, p. 69)* and am in complete agreement with the picture it presents. You and your staff are to be complimented on what appears to be an accurate and comprehensive picture of this relatively new field.

C. T. Stone
Sales Engineering
Esso Standard Oil Co.
New York

Complete on Mud

To the Editor: We were quite impressed with the article on drilling mud makers (*May 2, p. 33*). It is an excellent article and one of the most complete on oil well drilling muds we have seen.

J. W. Hurley
Manager, Market Research
A. E. Staley Manufacturing Co.
Decatur, Ill.

Summer Antifreeze

To the Editor: We have noted the following (*CW, April 18, p. 60*):

"The U.S. motorists' demand for cooler summer driving has helped bolster sales of glycol antifreeze. The increase has come through sales to auto makers who install air-conditioning units that contain the permanent type of antifreeze."

From this article, we would infer that permanent-type antifreeze is used in the air-conditioning system. Actually, the engine-cooling system and the air-conditioner circuits are entirely separate.

According to literature provided by the car manufacturers, antifreeze is recommended for summer use in the cooling system of the following vehicles equipped with factory-installed air conditioners:

Chevrolet—1955 and '56 (Frigidaire unit only).

Chrysler Corp. cars—'57, '58 and '59.

Lincoln—'58 and '59.

In these air-conditioning units, the car-heater core is located adjacent to the air-conditioner evaporator; and, to avoid possible freeze-up of coolant in the heater core, antifreeze is recommended for summer operation. By replacing the winter-worn antifreeze in the spring with a fresh fill protecting to at least +10 F (25% concentration), the car owner will ensure adequate cooling-system corrosion-protection during hot, summer driving. . . .

N. R. Cooper
Automotive Engineering Dept.
National Carbon Co.
New York

Another View on Wax

To the Editor: We have for many years followed your publications. On the subject of wax, which is our field of endeavor, we fail to agree with some of your recent articles.

As long as you have published your latest one (*Feb. 28, p. 56*), it would be only fair to give you the other side of the story.

First of all, no large shipments of Japanese paraffin wax have come into this country. Some very small ones have come in and might continue to come in. This makes absolutely no sense at all. While the price may be slightly lower (though the difference is very small), no large-scale U.S. wax consumer will base himself on imported waxes that have to travel large distances and cannot compare in quality with our product here.

In addition, large wax consumers in this country either buy theirs in tank cars or tank wagons, which evidently eliminates the Japanese wax; or they purchase in pallets, which again would make imported wax somewhat difficult to handle.

To conclude, the imported waxes have an oil content of about 0.4 to 0.5 compared with domestic fully refined of 0.15 to 0.25.

They have a color of around 25, whereas our domestic waxes have a 30-plus color.

Seal strength, blocking temperature and tensile strength are all inferior to U.S. waxes.

As far as the price is concerned, the fully refined wax in tank wagons cost 7.65¢/lb. at the refinery. It costs 8.55¢/lb. for slabs on pallets at the refinery, and 9.25¢/lb. for slabs in cartons at the refinery.

The imported material arrives here at prices (including ½¢ for import

3M COMPANY CHEMICALS THE RAW MATERIALS OF PROGRESS

KEL-F® SEAL PROTECTS CAPACITANCE

Keeping a cap on runaway current at extreme temperatures demands a rugged hermetic seal. That's why Fansteel Metallurgical Corporation has chosen KEL-F Brand Halofluorocarbon Elastomer seals (arrow) to boost the temperature performance of its sub-miniature "HP" Type Tantalum Capacitors from 85°C. to 125°C.

But more than just a wide temperature range was needed. And KEL-F Elastomer provided the unique combination of properties Fansteel required. The elastomer is not only remarkably stable dimensionally, it also gives the resiliency needed to effect a permanent hermetic seal. And it is chemically inert! Thus, corrosive materials in the capacitor won't affect the seal even when they are hot or carrying large electrical loads. (KEL-F Elastomer exhibits excellent electrical properties, too.) What's more, the seal won't oxidize at high temperatures!

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CHEMICAL DIVISION

MINNESOTA MINING AND MANUFACTURING COMPANY

...WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

OPINION

duty and union charges for pier unloading) ranging from 7.75¢ to 8.25¢/lb. This does not include the profit for the importer.

Thus, it is evident that, with the disadvantages pointed out above, this cannot develop into a large-scale business.

There is, however, an excellent market for these waxes in South America, where U.S.-produced fully refined waxes are being replaced, particularly in the candle industry. Here the Japanese fully refined grades work out advantageously, due to their slightly higher oil content.

There is another rather misleading statement in your article, mentioning that large quantities of microcrystalline waxes are being imported into this country. Again, the occasional lots coming in are just a drop in the bucket, and in the long run this country will always be the exporter, and, therefore, hardly the importer of petroleum waxes at the same time.

A. AUFHAUSER
Industrial Raw Materials Corp.
New York

MEETINGS

Fifth World Petroleum Congress, Coliseum, New York, June 1-5.

Material Handling Institute, Exposition of 1959, Public Auditorium, Cleveland, June 9-12.

Instrument Society of America, international symposium on gas chromatography, Kellogg Center for Continuing Education, East Lansing, Mich., June 10-12.

Manufacturing Chemists' Assn., 87th annual meeting, The Greenbrier, White Sulphur Springs, W. Va., June 11-13.

Parenteral Drug Assn., dinner meeting, Sylvania Hotel, Philadelphia, June 12.

National Industrial Pharmaceutical Research Conference, King's Gateway, Land O'Lakes, Wis., June 14-17.

Technical Assn. of Graphic Arts, annual meeting, Manger Hotel, Rochester, N.Y., June 15-17.

Gordon Research Conferences; separation and purification, at Colby Junior College, New London, N.H.; chemistry and physics of liquids, at New Hampton School, New Hampton, N.H.; lipide metabolism, at Kimball Union Academy, Meriden, N.H., June 15-19.

Instrument Society of America, second nuclear instrumentation symposium, Idaho Falls, Ida., June 17-19.

International Plastics Exhibition and Convention, Grand and National Halls, Olympia, London, England, June 17-27.

VIEWPOINT

ATOMIC DEVELOPMENT has so many ramifications that a consistent program to encourage entry of private industry would be difficult to come up with.

But, as the Atomic Energy Commission's nuclear power development program moves ahead, we cite one area—and there are several—where neglect today may mean larger bills for the government, and for us, tomorrow.

We're specifically concerned with the investment AEC might make to encourage private industry to get into nuclear fuel reprocessing. Everyone admits that it's risky for a commercial firm to do work in this area; and the risks are enough greater than the rewards that it's still economically unattractive (a subsidy might be the answer). Thus, few companies have seriously thought of entering this field.

Although AEC has repeatedly said that it would be happy to turn reprocessing over to private business, the government still handles it. And no private firm gets the economic or technical experience in the problems it would have to face in private operation.

Now, AEC and the European Atomic Energy Community (Euratom) have asked for proposals for nuclear power plants to be built in western Europe. And one of the types of assistance the U.S. will give is this: AEC will make available, over the long term, chemical reprocessing services for fuel supplied by the U.S. on terms comparable to those offered U.S. reactor operators.

Since costs of today's batch-type reprocessing are quite high—a good deal more than AEC charges—the commission may well be committing the U.S. taxpayer to long-term underwriting of continued AEC reprocessing at a loss.

If AEC is indeed not trying to perpetuate its reprocessing program, why isn't it offering some real incentives for private firms—both in the development of new methods of reprocessing and in the construction and operation of private facilities?

H E Johnson
Editor-in-Chief

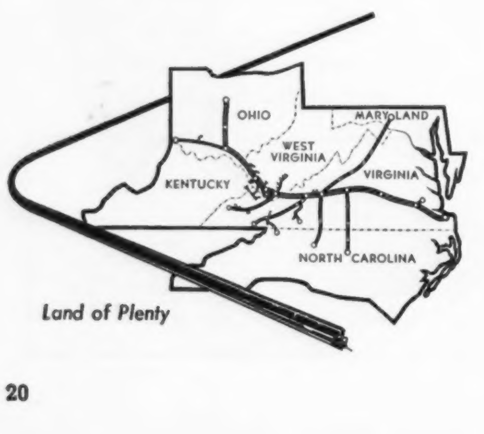
if you're planning a new plant to produce . . .

Phenol
Anthracine
Benzene
Toluene
Xylene
Napthalene
Pyridine
Cresol
Ammonia

When you consider a new plant to produce coal-based chemicals, a logical starting point is the six-state area served by the Norfolk and Western Railway. Within this territory you will find vast reserves of all-purpose top-quality Bituminous Coal.

You can choose from high, low and medium volatile coals; you can select the coal with the fixed carbon, sulfur and moisture content that best suits your processing needs. Modern mining and expert preparation methods enable you to specify the coal that meets your exact requirements.

And this progressive territory also provides multi-million-ton deposits of dolomitic and high-calcium limestone, and manganese, silica, clays, zinc, marls and other minerals in commercially economical quantities. Water is abundant, with six of the nation's principal rivers, in addition to wells, lakes, tidewater and rainfall 30% above the national average. Installed electric utilities generating capacity comprises one-sixth of the nation's total. And your transportation needs will be dependably served by the N&W. In addition there is a good supply of home-rooted workers, friendly communities, reasonable taxes, and sensible real estate prices. Let our plant location specialists know your needs, and they will give you specific details in confidence. Get in touch with . . .

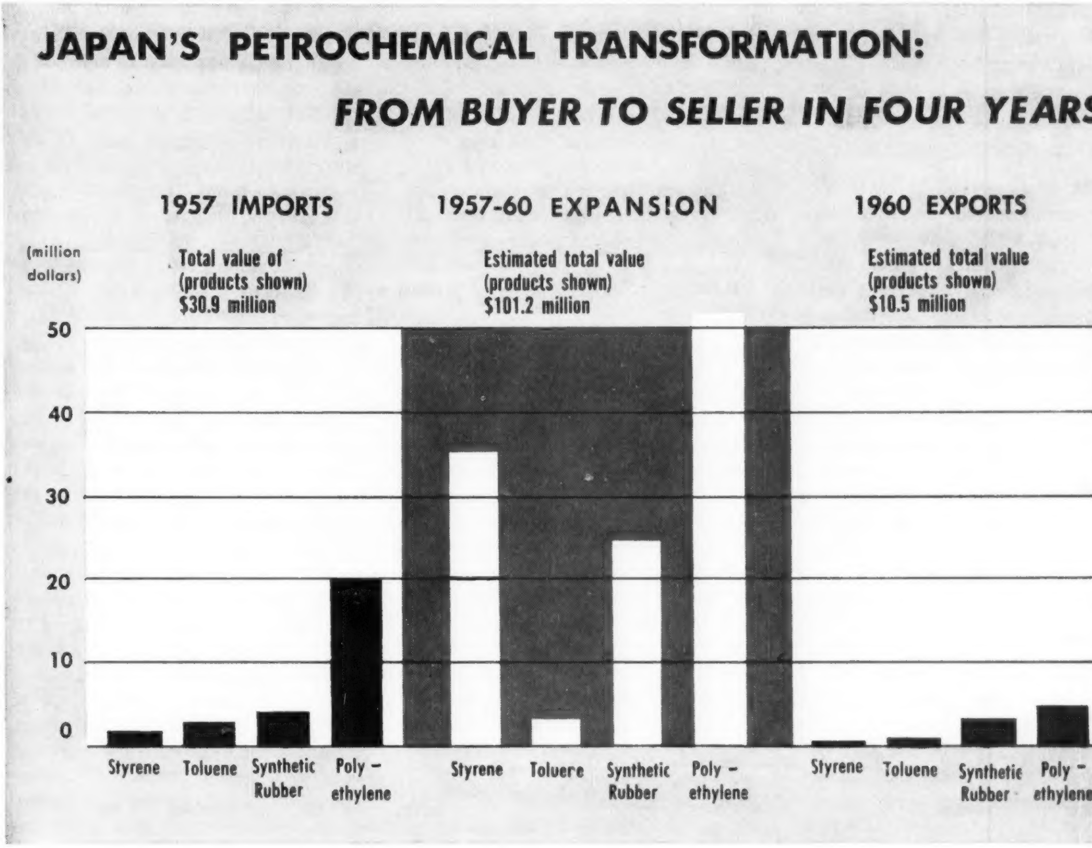


Land of Plenty

L. E. Ward, Jr., Manager
Industrial and Agricultural Dept.
Division CW-839 (Phone DIamond 4-1451, Ext. 474)
Norfolk and Western Railway
Roanoke, Virginia

Norfolk and Western
RAILWAY

Chemical Week — May 30, 1959



Japan Seizes Petrochemical Export Role

Two internal struggles simmering in Japan this week mark that nation's efforts to keep its four-year-old petrochemical industry growing and expanding. The U.S. has a big stake in the program — Japan's petrochemical independence could mean a cutdown of imports from the U.S.

• One conflict is over the seam-busting growth rate of this and other industries. Premier Nobusuke Kishi — like President Eisenhower — is worried about the possible consequences of overconfidence, overexpansion and overspending. And though the long-range effects of petrochemical buildup will be to reduce Japan's imports and increase its export sales, the immediate effect would be a strain on Japan's foreign exchange, due to stepped-up buying of equipment and know-how. Accordingly, the Kishi government is trying to limit this year's petrochemical expansion to only about half the capital investment favored by industry management.

• The other clash concerns the use of foreign technology, which has been particularly important in the Japanese petrochemical industry.

Attempts to reduce or eliminate Japan's reliance on foreign technology have been mounted. Official opposition comes from the Ministry of Finance, which seeks to cut foreign exchange expenditures wherever possible. Added to this is the voice of a growing group of scientists and others who are motivated by political as well as professional reasons.

More New Entries: Japanese petrochemical management men are battling against both moves to put governmental restrictions on their expansion programs. Just this month, they took part in the special meeting of the Federation of Economic Organizations — Japan's equivalent of the National Assn. of Manufacturers in the U.S. — called to map a campaign against the Finance Ministry's increasing tendency to withhold approval on new technological agreements with foreign firms.

And at least three companies not yet in petrochemicals are striving to join the 13 companies with petrochemical plants already in production or under construction (*table, p. 22*). But they need governmental clear-

Japan's First 42 Petrochemical Projects, 1957-61 (Production capacity—tons/year)

	Asahi-Dow	Furukawa Chemical	Japan Catalytic Chemical	Japanese Geon	Japan Petrochemical	Japan Synthetic Rubber	Maruzen Oil	Mitsubishi Chemical	Mitsubishi Petroleum	Mitsubishi Petrochemical	Mitsui Petrochemical	Showa Petrochemical	Sumitomo Chemical	TOTAL NEW CAPACITY	SURPLUS FOR EXPORT	NEED FOR IMPORTS
Acetone					6,800						3,500			10,300	800	
Acrylonitrile													7,000	7,000		
Benzene							6,240		4,700		8,760			19,700		300
Butadiene					5,150									5,150		
Butanol							2,400							2,400		1,100
Ethylene					35,000					22,000	26,000		12,000	95,000		
Ethylene glycol			3,840							3,000	4,800			11,640		960
Ethylene oxide			1,800							2,700	2,400			6,900	300	
Isophthalic acid							5,014							5,014		
Phenol											12,000			12,000	2,000	
Phthalic anhydride							2,042							2,042		
Polyethylene		9,000								10,000	12,000	10,000	11,000	52,000	5,000	
Polystyrene	8,100							6,000						14,100		
Styrene monomer	18,000									18,000				36,000	1,200	
Synthetic rubber				8,500*		33,000**								41,500	6,500	
Terephthalic acid							2,200				6,000			8,200		1,400
Toluene							6,000		3,500		11,220			20,720	4,720	
Xylene							9,600		3,000		11,220			23,820		3,180

* Special styrene-butadiene rubber, 5,800 tons; nitrile rubber, 1,500 tons; high-styrene rubber 1,200 tons. ** All styrene-butadiene rubber.

ance on their proposed projects.

These three prospective new entries and their proposed projects:

- Toa Nenryo (East Asia Fuel Co.) plans to add petrochemical manufacturing — initially, 10,000 tons/-year each of polypropylene and tetraethyl lead — to its petroleum refining operations. Toa Nenryo is a subsidiary of Standard-Vacuum Oil Co., which is jointly owned by Standard Oil (New Jersey) and Socony Mobil Oil; and its proposed petrochemical plant at Kawasaki would be built with technical assistance from Esso Research & Engineering Co.
- In a proposed $11-million joint venture, Idemitsu (another petroleum refining company) and Nissan Chemical (fertilizer producer) would build a plant at Tokuyama to produce 10,000 tons/year of polypropylene and some other product, so far undisclosed. This would be based on a licensing agreement with Italy's Montecatini.
- Also on the southern tip of

Honshu and with technical aid from Montecatini, Kyowa Fermentation Industry — affiliated with Mitsui, the country's largest trading concern—is seeking governmental go-ahead on its $20-million venture at Ube. This plant would produce 7,400 tons/year of octanol and 10,000 tons/year of butanol by thermal decomposition of naphtha.

Pioneers Not Standing Pat: Meanwhile, the government's Ministry of International Trade and Industry (MITI) also is getting applications for new projects from the 13 companies already in the petrochemical business. In particular, Mitsui, Mitsubishi and Sumitomo — "Big Three" of the industry — are bent on producing polypropylene, octanol and acrylonitrile within the next few years. In fact, Sumitomo already has started making acrylonitrile, turning out 1.5 tons/day at its $7-million Niihama plant. This output goes into production of Sumitomo's acrylic fiber, Exlan, in which American Cyanamid has an interest.

This touches on the heart of what petrochemical expansion means to Japan. In essence, it's a matter of bolstering the nation's biggest industry — textiles — in world trade. The connection runs like this: Textile export sales are the biggest single factor in the Japanese economy; new and improved synthetic fibers are needed to keep Japanese textiles from losing ground in world trade; the most economical way to obtain these modern fibers is to make both the fibers and the intermediate chemical products in Japan; and petrochemicals are winning out over the coal-tar chemicals from the country's older plants. This is despite the fact that, although Japan is now making considerable progress with domestic production of natural gas, it still has to import 97% of its petroleum needs.

Savings on Imports: However, the petrochemical buildup in Japan has other consequences of closer concern to U.S. chemical companies. For one thing, it means that Japan itself will not be buying the same large quantities of petrochemicals—mostly from the U.S. — that were flowing into that country in former years.

The first petrochemical five-year plan — launched in 1955 and now nearly completed — is costing $230 million in capital investments, including $35 million in licensing fees and $22.5 million for foreign equipment. But it is cutting sharply into petrochemical shipments to Japan (*chart, p. 21*). In the first half of 1958, Japan's petrochemical industry saved the country an estimated $13 million on imports; and by next year, the annual saving is expected to be about $120 million.

Also Japan is now becoming an important exporter of petrochemicals and plastics. Examples: total 1958 plastics exports were 10.8 million metric tons; this year, the goal is more than 17.9 million.

It's true that numerous U.S. chemical companies are partners in the Japanese petrochemical industry. But to a large extent, Japan is now changing from a customer to a competitor for U.S. producers.

New Ban on Know-How

New and tougher government controls on exports of petrochemical know-how to the Communist bloc are stirring up a wave of speculation and concern.

The reactions were loud at the American Institute of Chemical Engineers' 40th annual meeting in Kansas City. There delegates shrugged off the possible impact of the new rules on their business with the Red bloc, but expressed real worry about their interests in western Europe.

The new rules, set forth in Commerce Dept. Bulletin 814, were explained to the delegates by Rauer Meyer, a department official. They cover exports of unpublished or not generally available technical data relating to petrochemical plans and processes.

Under existing regulations, companies must get a general license to send such information to non-Communist countries. To send it to Communist nations requires a much-harder-to-get special license.

The new regulations, which go into effect June 8, are an attempt to prevent transhipping data covered by a general license to a Communist destination. Here's where the worry about western Europe enters: exporters with a general license will now have to get written assurance from their non-Communist receivers that the technical data and even its primary products—which could include chemicals—will not eventually wind up behind the Iron Curtain. Moreover, if this happens and it's found that the exporter suspected that it might occur, the exporter risks a $10,000 fine and a year in prison.

Industry men at the AIChE meeting expressed greatest concern over the restriction on shipment of products made with exported data. West European producers would readily agree not to sell U.S. know-how to the Communists, many delegates asserted, but they may well balk at restrictions on where they sell their goods, especially since the agreements would have no time limit.

Schering Sights High

"I want to convey more than the usual optimism for our future . . . regardless of what 1959 may bring." That's what Schering Corp. President Francis C. Brown recently told shareholders, and that's what Treasurer Mortimer Fox emphasized in his talk last week to Washington security analysts.

Reasons behind their cheer: at least three promising acquisitions on tap, a better-than-average capital spending program for '59, a comfortable cash reserve, and a broad research effort.

Fox revealed the company has set aside $5 million this year for capital improvements. In addition, he said, several acquisitions overseas are in the "discussion stages."

The merger candidates are believed to be proprietary drug manufacturers, "some in Europe and one in South America." Fox didn't elaborate. But he did say that any purchases of foreign firms would probably be for cash.

These outlays—which Fox implied would be substantial—are possible because of Schering's large on-hand reserves. Right now, the company has $34 million in cash and marketable securities—a sizable amount, in relation to its '58 sales of $75 million.

In steroids, reports Schering's treasurer, the company supplied about 30% of an $85-90-million market in '57. But, because of new competition, this declined to 20% of '58's $95-million total. "At the present time," added Fox, "Schering still holds about 20% of the market . . . which is continuing at $95 million."

For research, Schering has budgeted about $7.5 million, equivalent to 10% of sales. Much of the effort will remain in the steroid field, although Fox also singled out central nervous system drugs, new vaccines, biologicals, and animal health products as expanding research targets.

At hearing, tobacco farmers speak up for ag chemical under attack.

MH-30 Sparks Tobacco Tiff

Tempers were flaring in North Carolina this week as the state senate neared a showdown on a bill to outlaw use of maleic hydrazide—Naugatuck Chemical's MH-30—on tobacco plants.

The senate's agriculture committee voted to report favorably a bill banning use of the chemical. MH-30 has been widely used to prevent growth of tobacco suckers—fast-growing sprigs that sprout on maturing plants and use up plant food that otherwise would go into the marketable leaves.

The legislation would make it unlawful to apply MH-30 to flue-cured tobacco plants, to sell it for use on tobacco, or to advertise it as suitable for use on the leaf. And containers of MH-30 would have to bear the label "unlawful to be used for, or sold for use on, growing tobacco."

Four Backers Switched: Committee approval of the bill seemed for a time unlikely after four of the eight senators who introduced it backed down later (*CW Business Newsletter, May 23*). On reconsideration, these original backers voiced opposition on the ground that there is not enough evidence of the chemical's allegedly harmful effects.

One of the opponents of the proposed law — a signer of the bill when it was introduced — tried to get the committee to defer action, but was soundly defeated. Sen. Adam Whitley of Johnston County, a heavy tobacco-growing area, asked for more study on the chemical before outlawing it.

Proponents of the bill say MH-30 hurts leaf quality. Tobacco buyers and cigarette manufacturers said at a public hearing earlier this month that the treated leaf gets "slick, soggy and leathery." They predicted its continued use would hurt the tobacco markets.

Savings Cited: Farmers turned out 300 strong at the public hearing last fortnight. Most voiced opposition to the bill. They argued that the old method of removing tobacco suckers — breaking them off by hand — requires about 30 man-hours/acre. By using MH-30, they reported, the grower gets the sought-after increased yield — worth up to $250/acre—and also saves $25-30 on labor costs.

U.S. Rubber, which first tested the product on tobacco in '48, maintains that proper use of maleic hydrazide improves quality of the leaf. While conceding that improper use can damage tobacco, the company points out that improper irrigation, too much fertilizer, poor spacing, premature harvesting and many other factors can have the same effect.

But senators favoring the law in committee say farmers in their counties want the ban. One senator, Grady Mercer of Duplin County, asked, "How many piles (of tobacco) is U.S. Rubber going to buy if the chemical continues in use and tobacco buyers won't handle the crop?"

Mercer charged that U.S. Rubber did "a good job . . . to round up all those farmers [to] come up here and sabotage their [the farmers'] own program."

Exhaustive Study Asked: Two state senators against the bill have already asked for a study commission, composed of farmers and buyers, "to make an immediate and exhaustive study of this question to the end that North Carolina will continue to be the world's leading producer of quality tobacco."

Moreover, the Raleigh, N.C., *News and Observer* reports more opposition is coming from people who wonder "just how far the state can go in regulating the production practices of tobacco farmers. . . . if this measure is enacted, there may be another one next year to regulate row width or plant spacing, another the following year to specify how much water can be applied at each irrigation — and so on."

There are objections, too, from farmers who point out the proposed law would ban use of MH-30 in North Carolina but would not affect its use in the other states that are growing flue-cured tobacco.

Some go so far as to call the bill unconstitutional, since, they allege, it would take away the grower's right of choice to use what he wants on his crops—"contrary to democratic principles."

In any case, now that the bill has committee approval, it was slated to go to the senate floor this week for debate and a possible vote. The bill is expected to be among the most hotly disputed issues of the session. Should it pass in the senate, it would go to the house of representatives — for more spirited debate. So far, however, the bill hasn't been introduced in the house.

EXPANSION

Aluminum: Kaiser Aluminum & Chemical Corp. will boost production of high-purity aluminum at its Mead, Wash., reduction plant from 300,000 to 900,000 lbs./year. Construction of two large refining cells will begin immediately, with completion slated for this fall. Cost: $100,000.

•

Industrial Gases: Air Reduction Pacific Co., division of Air Reduction Co., Inc., has started construction of a $3-million air liquefaction plant in Richmond, Calif. The unit is designed to turn out 30 tons/day of liquid oxygen, liquid nitrogen and purified argon. Stolte, Inc., is the contractor.

•

Paper: Inland Container Corp. (Indianapolis, Ind.) and Mead Corp. (Dayton, O.) have formed a new, jointly owned subsidiary, Forest Kraft Co., to finance expansion of a mill operated by Rome Kraft Co. (Rome, Ga.), also jointly owned by Inland and Mead.

Plans call for construction of a pulp mill and installation of a 500-tons/day containerboard machine. Inland will contribute $13.5 million to the venture; Mead will exchange its minority holdings of Inland common stock for a 50% interest in the new firm.

•

Petrochemicals: Phillips Petroleum Co. has elaborated on earlier reports of Houston Ship Channel property acquisitions (*CW Business Newsletter, May 16*). The company now reports its latest purchase totaled 320 acres, bringing its holdings in the area to about 1,100 acres. Of the original 1,140 acres at the site, Phillips sold 216 acres to Celanese Corp. of America and 139 acres to National Petro-Chemicals Corp.

COMPANIES

National Gypsum Co. has acquired Huron Portland Cement Co. in a stock transaction. Terms of the $70-million deal called for a swap of 1,014,300 Gypsum shares for all 1,449,000 outstanding shares of Huron.

The acquisition will add about $35 million to Gypsum's annual sales—boosting estimated '59 volume to a record high of $215 million.

•

Ciba Co. Inc. will move its headquarters from downtown New York city to a newly completed building in Fair Lawn, N.J. Included in the move will be all elements of the firm's central staff, customer service laboratories, central warehouse facilities, metropolitan district sales offices, and laboratories.

•

Texaco, Inc., is acquiring Experiment, Inc. (Richmond, Va.), through an exchange of stock. Experiment, Inc., primarily a high-energy fuels researcher, has done most of its work under Defense Dept. contracts.

Callery Chemical Co. has been awarded a $175,000 contract by the National Aeronautics and Space Administration to evaluate a new and classified rocket propellent. Details of the propellent are under security wraps, but it is said to pave the way for greatly increased rocket payload weights.

•

Aluminum Co. of America is reactivating one of two potlines closed down early in '58 at its Vancouver, Wash., complex. It boosts production at the plant from 60% to 80% of capacity. Another line, at the company's Point Comfort, Tex., operation, is also being reopened. Together, they raise Alcoa's average operating rate to 82% of capacity.

FOREIGN

Fertilizer/Israel: A group of American investors will buy Fertilizers & Chemicals Ltd., Israel's largest chemical firm—now government owned. The group, headed by industrialist Sam Rothburg, formed Israel Investors Corp., which will initially invest $560,000. Over a two-year period IIC will boost its investment to $2 million in F&C stock, then will receive an eight-year option to buy the government's share in the company. Investment will total about $12 million. The Israeli government has guaranteed a minimum annual dividend of 8%.

•

Carbon Black/South Africa: Phillips Petroleum Co. and Industrial Development Corp. of South Africa, Ltd., will build a 22-million-lbs./year oil carbon-black plant in South Africa. They have formed a jointly owned firm, Phillips Carbon Black Co. (Proprietary) Ltd., to build and operate the unit. It is scheduled to be onstream within two years, will use Phillips' basic oil furnace-black process.

•

Rayon/India: Von Kohorn International, a U.S. firm, in collaboration with a group of Indian industrialists, formed Indian Rayon Corp. Ltd. They will build a $7-million, 10-tons/day rayon plant in Veraval (Bombay), India. The firm has $21-million authorized capital, $4.2-million paid-up capital. Indian promoters have taken up stock valued at $1.3 million; Von Kohorn has subscribed to shares worth $840,000. About $2.1 million worth is being offered publicly.

Construction of the new plant will begin next month, with startup scheduled for mid-'60. Initial production will be 5 tons/day.

•

Urea/Indonesia: The Indonesian government has signed a contract with Foster Wheeler Corp. (New York) for construction of a 330-short-tons/day prilled urea plant near Palembang, Sumatra, Completion is tentatively scheduled for late '62. Financing is expected to come from the Export-Import Bank. Cost: $30 million.

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Bagpak Division **INTERNATIONAL PAPER** New York 17, N.Y.

Washington
Newsletter

CHEMICAL WEEK
May 30, 1959

Proposed "price notification" legislation is under fire. The Manufacturing Chemists' Assn. told the Senate Antitrust Subcommittee that the bill to require concentrated industries to publicly justify price increases would be incompatible with free enterprise.

MCA says that such procedures would, among other things: (1) discourage price reductions for fear of difficulty in raising them again; (2) inhibit price flexibility; (3) force companies to meet increased costs by cutting quality; (4) hinder product improvements that might be expensive; (5) accentuate instability through inventory-building, when price increases are pending; (6) squeeze profits.

The AFL-CIO, steelworkers and independent economists have joined business and industry in fighting the proposal.

•

Acceleration of the civilian atomic reactor program, anticipated when the Democrats whooped into Congress with a big majority, is falling by the wayside.

The Joint Committee on Atomic Energy was expected to build at least one of the 200-300-megawatt nuclear plants for which it had ordered design studies. At first, Democrats lambasted the Administration's "pitifully inadequate" atomic program. But the $100-million appropriation the Democrats are now ready to approve is a modest sum, offensive to none of the private power interests.

The cooling off on big spending is due to these factors: improving economy; brandishing of the veto by the President; preoccupation of Sen. Clinton Anderson (D., N.M.), chairman of the joint committee, with fighting the appointment of Admiral Lewis Strauss as Secretary of Commerce; Sen. Anderson's increasingly good relations with the new AEC chairman; soft-pedaling of power reactor development all over the world—which makes it harder to justify stepping up the U.S. effort for the sake of keeping leadership; and inclusion of two projects in pending legislation for rural co-ops and city-owned power companies, thus softening the opposition of the public power group.

•

Look for new regulations on use of veterinary drugs, to be issued by the Food & Drug Administration in about two weeks. These will spell out the permissible residue in meat from animals treated with antibiotics and other drugs used. The new food additives law gives FDA this authority. The new regulations will also deal with drugs that may cause cancer—those agents banned entirely by the food additives law.

•

The new color additives bill will go to Congress within a couple of weeks, in hope of getting action this session. FDA, after lengthy consulta-

tion with industry, has turned the final draft over to the Budget Bureau for clearance. The bill allows use of potentially toxic colors in low, safe tolerances.

•

Antitrust charges against two leading producers of barite are being aired before the Federal Trade Commission. Competitors contend that acquisition of smaller companies by Dresser Industries and National Lead has given these two corporations 82% of the crude barite market, compared with 54% in '53. Dresser and National Lead are trying to show that their acquisitions were made to meet an increase in demand, not to cut down competition. A number of companies produce the mineral, used chiefly to give density and weight to oil-well drilling muds.

•

Seizure of adulterated foods has hit a new high. A step-up in budget and field inspectors for FDA over the past year is showing results. More than 400 inspectors are now in the field. During April, 227 tons of tainted foods, mostly mercury-contaminated wheat and DDT-loaded frozen spinach, were seized.

The mercurial compound on the wheat was supposed to be used only as a seed treatment. The spinach crop had been sprayed with 1.6 times the amount of DDT recommended by the Agriculture Dept. and was sprayed too close to harvest time. Other foods seized included 5,900 packets of powdered scrambled eggs, contaminated with salmonella bacteria, and four vitamin products.

The agency's budget for next year will be even bigger. The House has upped FDA's budget request from $11.8 million to $13.8 million, mostly to provide for proper enforcement of the new food additives amendment.

•

The Tennessee Valley Authority has "called attention to the fact" that some 50 of its equipment suppliers—furnishing products ranging from lightning arrestors and boiler tubing to electric circuit breakers and transformers—have been extending identical bids to TVA "for many years."

What TVA plans to do about it is uncertain, although the implication is that it may start buying a larger range of equipment from foreign suppliers. TVA says it is studying the situation—with a look at whether reliable overseas suppliers are available. Whether TVA would exclude domestic suppliers from bidding on specific items for which identical bids have been received, or whether importers simply would be added to the bidding, is not known.

Over the years, the antitrust agencies have tackled a variety of industries for alleged illegal identical-bidding practices on government contracts. Among them are steel and cement—and most recently, of course, the Salk vaccine makers.

Liquefied gases from Air Products equipment supply all major U.S. missiles.

HOW THE MILITARY SERVICES use Air Products CAPACITY

Large-scale low-temperature systems, ultra pure gases and liquids, and a broad range of specialized cryogenic "hardware" are supplied by Air Products to the military. When large quantities of liquefied gases were needed for rocket engine development and missile testing, Air Products quickly designed, manufactured and put on stream complete production facilities. Typical facilities paid for themselves in less than a year's time. Air Products also provides a broad line of portable air separators for field and shipboard use . . . and has advanced the development of exotic fuels. And, Air Products produces advanced design liquefied-gas pumps, cryogenic storage and transfer systems, electronic cooling devices and refrigeration and distillation equipment for military uses.

YOU will find here tangible evidence of a growing technology. Applying "Cryogenics" (the science of low temperatures) and engineering broad new routes to low-cost, high-purity industrial gases is the main business of Air Products.

Air Products combines original research knowledge with engineering and manufacturing capabilities and substantial operating experience. These integrated activities have

These companies and many others are the beneficiaries of major facilities provided by Air Products:
Acme Steel • Bethlehem Steel • Brazilian National Steel • Celanese • Dow Chemical • du Pont • Grace Chemical • Great Lakes Steel

Petrochemical plants use Air Products equipment in feedstock preparation and product purification.

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In the blast furnace, the open hearth and the new converter processes — Air Products oxygen efficiently increases steel mill capacity. Annealing nitrogen and other gases are also provided on a low-cost tonnage basis.

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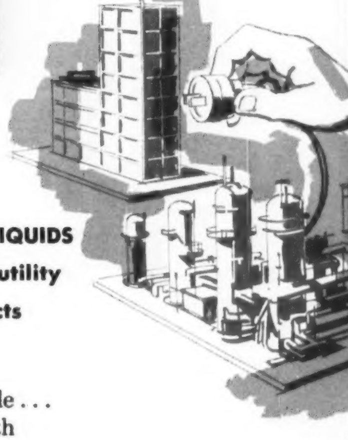

HOW THE CHEMICAL INDUSTRY uses Air Products CAPACITY

Air Products low-temperature systems permit many modern chemical plants to improve operating efficiency and end-product quality — and to develop new processes and products. This results from the ready availability of low-cost tonnage quantities of oxygen, nitrogen, hydrogen, ammonia and methanol syn-gas, carbon monoxide and hydrocarbons such as purified methane, acetylene and ethylene. Low-temperature separations of gaseous mixtures now make it practical to recover valuable components from natural gas, refinery off-gases, coke-oven gas and other "waste" gases. The versatility of cryogenics—as applied by Air Products—works profitably for the chemical industry today . . . offers unparalleled future opportunity in this fast-growing industry.

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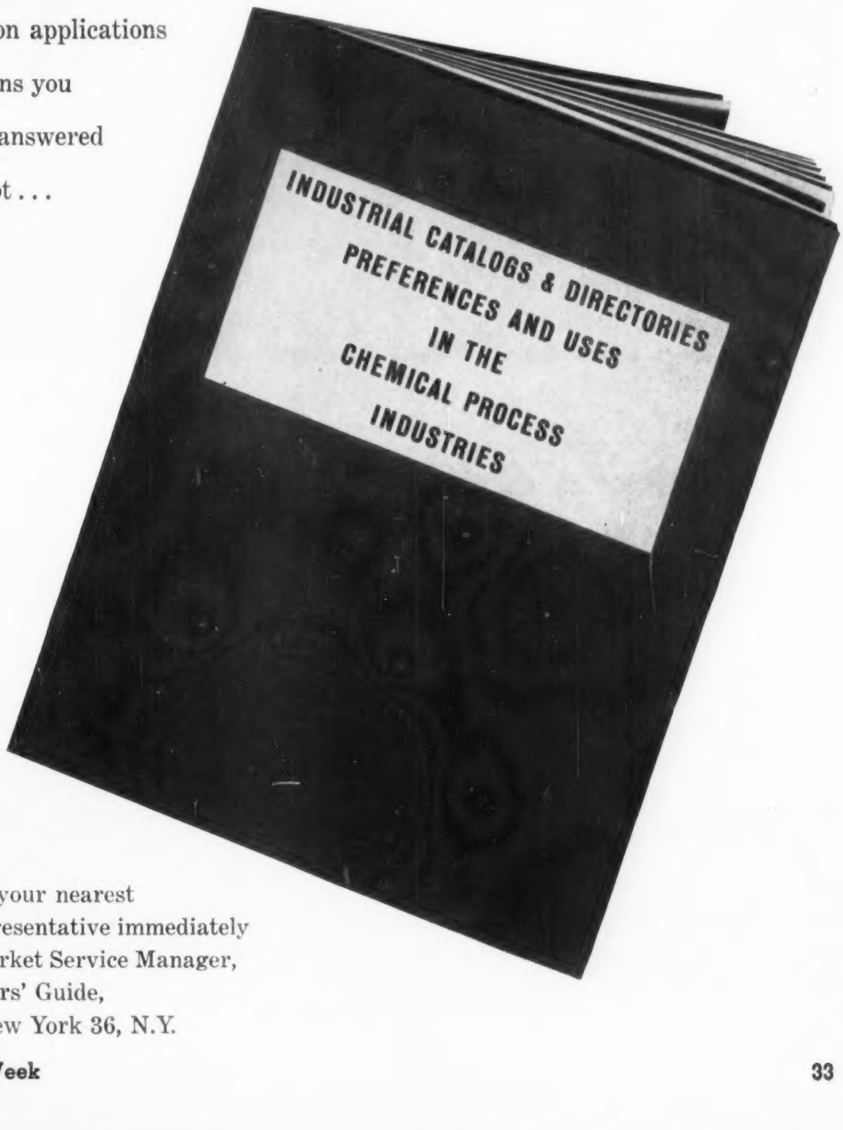

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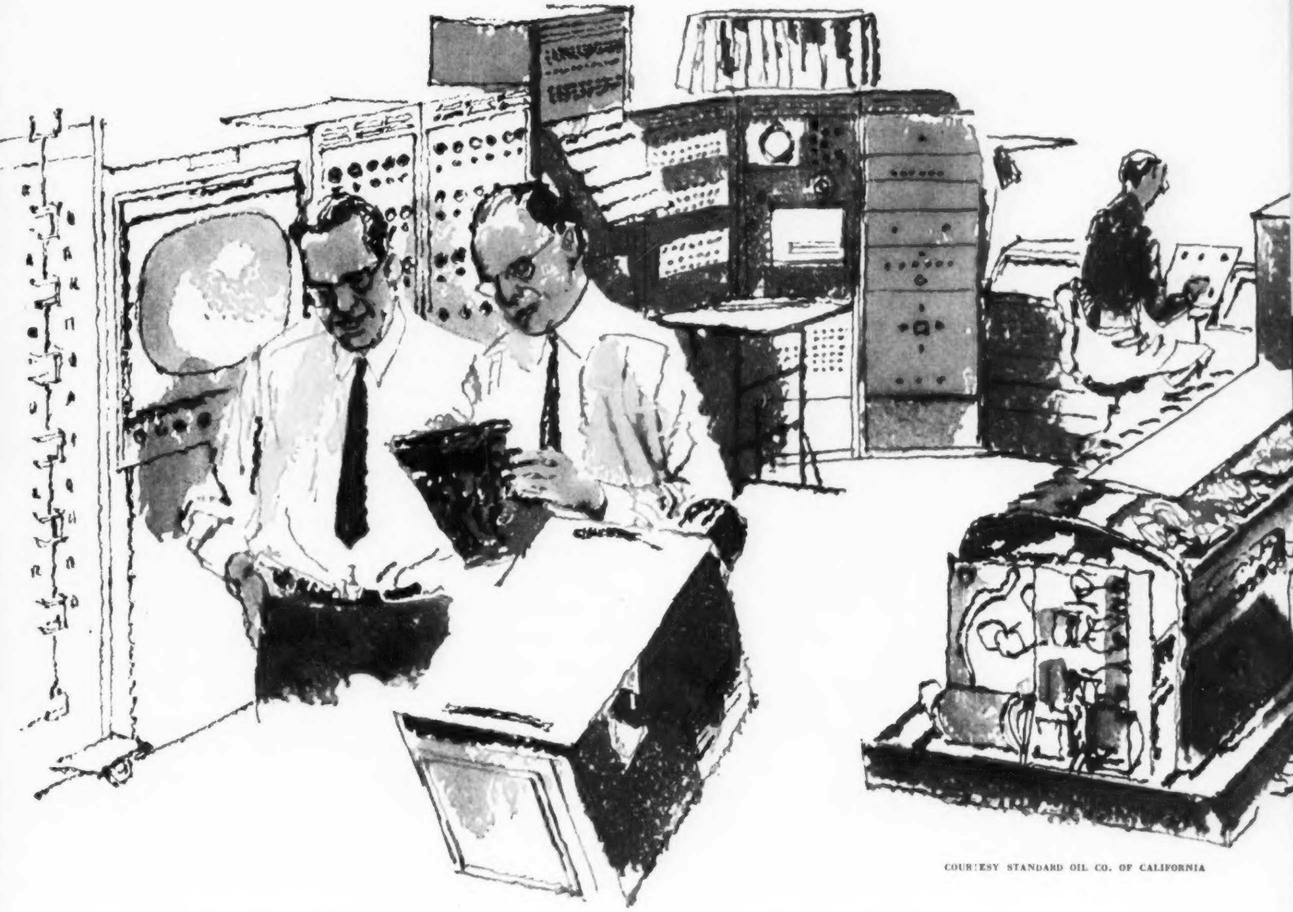


COURTESY STANDARD OIL CO. OF CALIFORNIA

Big research in action—big budgets and capital investment intensifies management's need for performance yardsticks.

Can You Rate Your Research?

How good is your research? Are you spending enough, too much? Are you selecting the right projects? Are you sure you are working in the right areas? Answering these questions may be the No. 1 management problem in the chemical process industries. On the following 11 pages is a survey of some of the best current thinking on the subject, what to expect of the scientific yardsticks that have been developed and—more important—what not to expect of them.

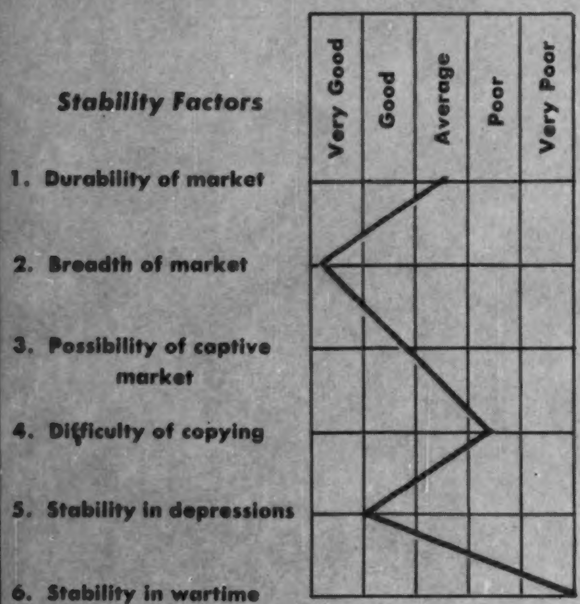
THE charts, checklists and indexes on the next few pages point up chemical management's growing determination to know what it is getting for its research money—with good reason. Figures compiled (from data supplied by manufacturers) for *CW* this week by McGraw-Hill's Economics Dept. show that:

(1) Companies that spend a relatively large percentage of their sales dollar on research expect new products to bulk big in their future sales statements.

(2) By and large, these same companies are growing faster than companies that don't pay much attention to research.

Charts, checklists and equations help research

1. PROFILE CHARTS



2. FORMULAS

Olsen's Index of Return:

$$\text{Index of Research} = \frac{\text{Value of research if successful} \times \text{chance of success}}{\text{cost of the research}}$$

Notes: For a process improvement, value of research is the full savings for one year.

For a product improvement, 2% of the sales of the product for two years.

For a new product, 3% of sales of the product for five years.

How to Use: If the index of return is less than 3, the project should be abandoned.

American Alcolac's Project Number:

$$\text{Project Number} = \frac{\text{chance of commercial success} \times \text{chance of technical success} \times \text{volume (in lbs. per year)} \times \text{price minus cost} \times \text{life (years)}}{\text{Total costs (costs of research, engineering, market development, plant, working capital and miscellaneous costs such as patent royalties)}}$$

Notes: Chance of success is expressed as a decimal between 0 and 1. On the "chance of technical success," for instance, a product being made by the company in a commercial unit would rate 1; in a pilot plant, between 0.9 and 1; on a lab scale, between 0.85 and 0.95. With no data available, it might be as low as 0.2.

How to Use: The project number is the ratio of estimated profits to estimated costs for a project, with the risk of the project weighted in. A project smaller than 1, then, should be abandoned. Its big value probably lies more in providing a mechanical system that emphasizes the need for procuring data on all phases of a project than as a method of comparing projects.

The $7-Billion Question: Such a broad statistical approach can readily demonstrate the general value of research. But it is of little help in evaluating a company's research program. And that may well be the No. 1 problem now facing modern corporate management—a problem that has been compounded and given new urgency by the heady growth of research expenditures.

No matter how you look at it, research today is big business. The total U.S. industrial research expenditure this year will come to $7.2 billion, or nearly 2% of the gross national product. That's equal to total U.S. research expenditures from 1776 to 1940.

Determining what kind of research will yield the greatest return on this investment of money and manpower is, of course, the object of attempts to measure the profitability of past research.

Opinion Poles: Research evaluation boils down to two questions: (1) Is the research department getting the proper allocation of funds? (2) Is the research manager spending the money he gets to best advantage? If the second question could be answered, the answer to the first would follow almost automatically.

There are, however, two opposing schools of thought on the practicality of trying to answer either question. On the one hand are those who argue that research is essentially a creative activity. They conclude that it cannot be measured because "you can't put a dollar sign on a good idea."

On the other hand, there is a body of opinion which states that research is a corporate function subject to the same sort of measurement that is applied to manufacturing, sales and the others.

Both of these extreme views are right—or wrong—depending on your point of view.

It's true that there is not now a definitive yardstick to measure research productivity, no magic formula that can digest a number of figures and yield a research score or rating. But there are a number of guides that can indicate whether research is performing as it should.

Du Pont, for example puts stock in a ratio of research investment to capital investment. The company points out that in its corporate history it has spent some $600 million for research, while it has put $1.8 billion into capital projects. This one-to-three ratio, moreover, has remained fairly constant during a period when research outlays have grown from $1 million to more than $70 million.

Du Pont President Crawford Greenewalt notes,* "The ratio of one to three, valid for both the short and long term, can, I think, be extrapolated . . . with reasonable confidence."

*In his book, *The Uncommon Man*, McGraw-Hill Book Co., 1959.

management evaluate project economics

R. W. McNamee, manager of research administration for Union Carbide Corp. goes along with the one-to-three ratio. He also notes that Carbide has been bringing out new products at the rate of two a month for an extended period.

And the one-to-three ratio is holding up well for Monsanto. In 1958, it spent $23.4 million for research, development and patent work and basic engineering; its capital expenditure was $72.6 million. Monsanto attempts to correlate research spending with increased sales, but includes other related figures—e.g., the actual savings effected by process research. Patents are also considered a concrete example of research results by Monsanto. In 1958, it received 269 U.S. patents, 273 foreign ones.

Instead of looking at one year's ratio of research expenditure to capital investment, Lionel Edie, chairman of the firm bearing his name, prefers to use a three-year cumulative research expenditure. This, he says, is in a fairly constant relationship with the rate of capital spending.

Dow evaluates its research by every conceivable means: sales increase, capital expenditures, patents, papers, new products, new uses for products and products improvements. Dow has introduced 77 new products since 1952. Its objective: to derive 10% of its sales from products not more than five years old. The 77 new products accounted for $50 million in sales, somewhat short of the goal; Dow's sales for fiscal 1958 were $636,201,143.

The feeling at Dow is that there is no direct tie between research and capital investment, because capital investment varies from year to year, while research tends to grow at an even rate. Historically, Dow has spent $7 on capital investment per dollar of research.

National Aluminate (Chicago) puts a solid 4% of its sales dollar into research. But Nalco Research Director John W. Ryznar doesn't put much stock in attempts to relate research to gross sales. He thinks the important thing is to find the contribution of research to new products. "This type of information," he says, "isn't found in a percent of sales figure."

For more than 12 years, Nalco has kept a careful record of sales of new products and research expenditures on each project. Says Ryznar of a five-year evaluation of these records, "The profitability of these new products has amply justified our research."

HAZARDS OF THE GAME

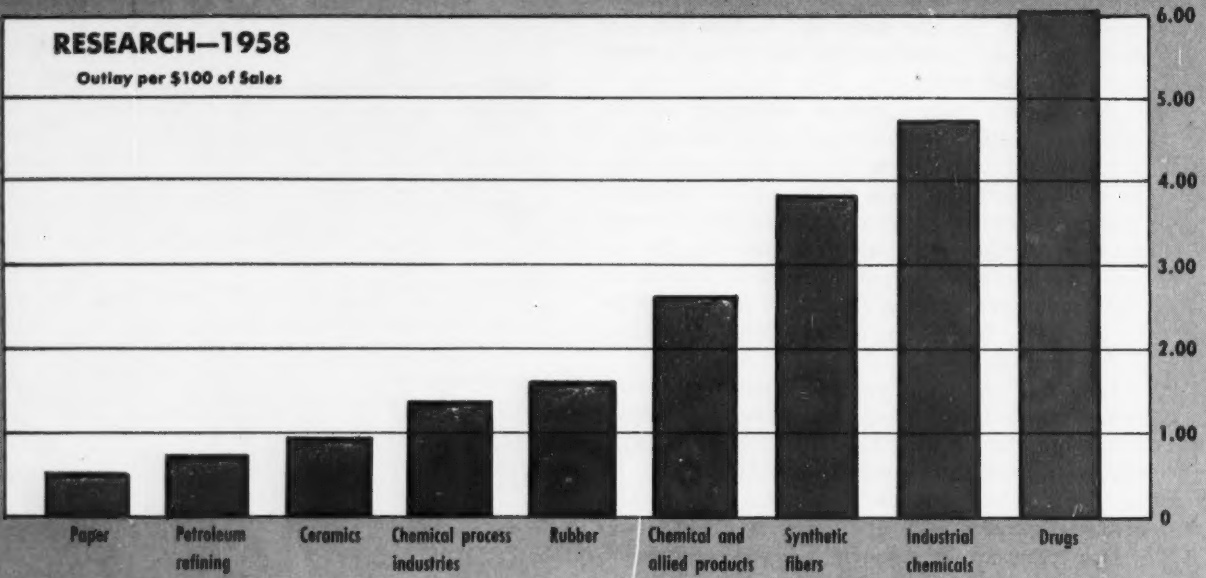
A number of formulas for measuring research profitability have been worked up. But before assessing them, management men should bear in mind these points of caution:

CHECK LIST

	Source of Information									
Factor	Accounting	Budget	Economist	Engineering	Manufacturing	Market Research	New-Product Development	Research	Sales	Traffic
Pricing to achieve objectives										
Profit		✓	✓				✓			
Market share						✓	✓		✓	
Volume							✓		✓	
Capital requirements and profits										
Return on research outlay	✓	✓								
Return on other new investment required	✓	✓								
Investment alternatives						✓	✓			
Relation to long-term plan										
Use of facilities in common			✓		✓				✓	
Unique features of new product										
a. Special sales training									✓	
b. Handling and shipping					✓					
c. Spoilage					✓				✓	
Process research: Effect of process change										
Time					✓			✓		
Material or labor					✓			✓		
Safety					✓			✓		
Quality								✓	✓	
Appearance								✓	✓	
Measuring gains										
Pro forma statements	✓								✓	
Return on research outlay	✓	✓								
Return on other investment required	✓	✓								
Financing capital requirements										
Long-term capital budget										
a. Cash flow			✓							
b. Payout period		✓								
c. Return on investment		✓								
Availability of new capital										
Cost of new capital										
Risk										
Product life						✓				
Relation to general business fluctuations						✓				
Strategic importance of product						✓				
Research proper										
Technology								✓		
Personnel								✓		
Facilities								✓		
Type of research								✓		
Production										
Technical feasibility				✓				✓		
Requirements to meet competition										
a. Production time				✓						
b. Physical properties								✓		
c. Skills required				✓						
d. Special materials								✓		
Customers' specifications										
Physical properties						✓		✓		
Sizes, colors, etc.						✓				
Potential demand										
Magnitude, current and prospective			✓							
Customers					✓				✓	
Market share					✓		✓		✓	
Distribution methods									✓	
Scale of plant										
Technical factors				✓	✓					
Special demand characteristics			✓	✓	✓	✓				
Location of plant										
Raw materials							✓			
Labor							✓			
Customers						✓				
Nature of customers						✓				
Transportation costs										✓
Operations										
Sales projections			✓			✓			✓	
Cost estimates				✓	✓					
Pro forma statements	✓	✓							✓	
Competition										
Prices, costs, and profits						✓				
Competitive advantages						✓			✓	

*Courtesy American Management Association

How much they spend for research



Comparing the size of a research program with that of the competition is often a problem of definition.

Most companies, in reporting "research" figures, include expenditures for research, development, engineering and technical services. This inflates the figure by the order of 10.

Mark Cresap, president of Westinghouse, says, "If you ask me how much money we spend on research, I have two figures I can give you. One is the honest amount—what we actually spend on exploratory research. The other I can give you will make us look good in comparison with our competition."

Because of the vagueness of terminology, General Electric doesn't talk about its research spending at all. It has, however, said that its budget as a percent of sales is three times the industrial average. That would peg its total budget for research, development and engineering at a whopping $240 million.

It's difficult to relate research spending to payoff, because of the time lag between the start of the research program and the time that revenue starts to accrue from a commercial plant.

A McGraw-Hill survey last year placed this time lag at seven years—a figure that is often honored in the breach. Carbide, for example, has put the phrase, "seven years from test tube to tank car," into the language. But Research Administrator McNamee points out that some projects now in test tubes have been there over 20 years. M. R. McCorkle, technical director of Armour Chemical Division, on the other hand, points out that his labs have many short-term projects; the time from their inception to commercial production is likely to be only two years.

Nevertheless, most companies go along with the seven-year figure as an average. Dow does. Monsanto put its own timetable at between five and seven years, pegs the chemical-industry average at 6.2 years.

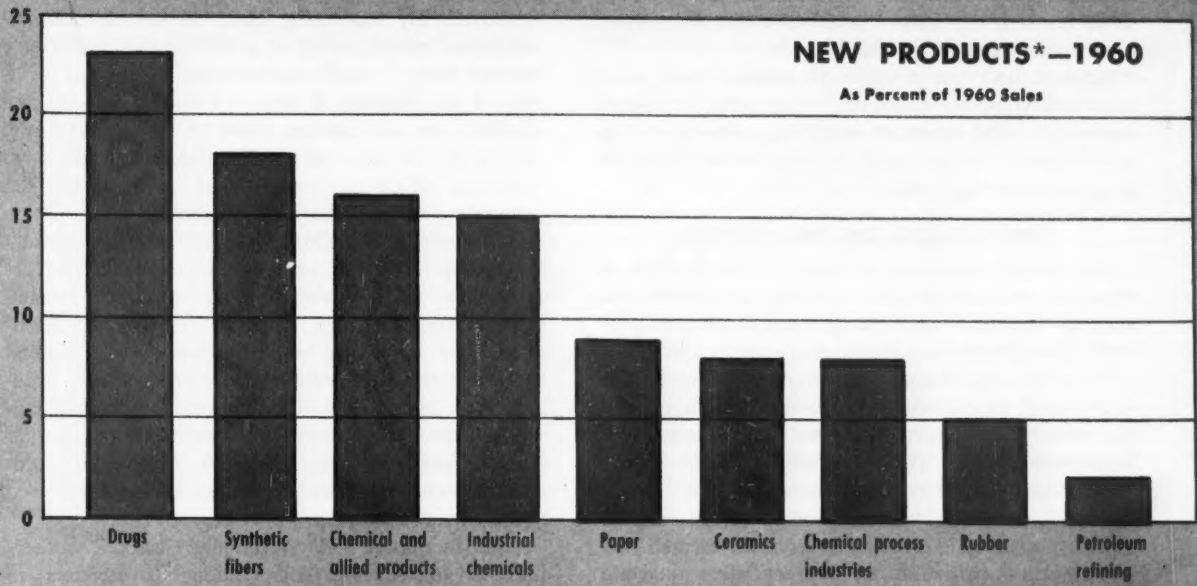
If research expenditures were growing at the same rate as sales or capital expenditures, this time lag would not be so important. But the fact is, they're growing faster.

The size and the scope of a research department varies with the size of the company and its product mix.

This makes it just about impossible to work out a formula that will be universally applicable. The rule of thumb at Du Pont, for instance, is that not more than one project in 20 will mature to a commercial operation. (Carbide feels this is a fair estimate.) Few small companies could afford such a ratio, for much the same reason that a small investor can't afford a balanced stock portfolio. He has to settle for blue-chip stocks or mutual funds. In either case, he's assured of a modest return. But he'll never get rich quick.

The number of papers published, patents issued or

is reflected in new-product hopes



*New products are defined as those not produced in '56 or products sufficiently changed to be reasonably considered new products. Source: McGraw-Hill Dept. of Economics.

new products introduced can be helpful in measuring research productivity; but they completely ignore the important "quality" factor.

There are other limitations on their use, too. Says Carbide's McNamee, "It depends on your objectives. In academic circles, the main idea is to publish papers, to disseminate information. Corporations vary greatly in their policies on encouraging research publication.

"In the field of patents, it depends on the area in which you're working. You must always weigh the possible protection you will get against the amount of proprietary information you give away.

"On new products, there's always the matter of definition. Take polyethylene. Would you call that one new product, or would you consider each of the 50, or so, variations of polyethylene as new products?"

The rising cost of research complicates forecasting from past performances.

Dow's Research Director, Ray Boundy, points out that it costs twice today what it did 10 years ago to support a technical man in a laboratory. This is offset —and complicated—by the fact that new equipment (particularly instruments) and improved techniques (e.g., statistical design of experiments) have helped the individual researcher become more productive.

There is no guarantee that the past productivity can be successfully projected.

Says Carbide's McNamee: "In our company, we have spent as much on research in the past seven or eight years as we did in all the years before that. In other words, we hit the half-way mark around 1950-51. We can get a pretty good idea of what the first half did for us. But what assurance do we have that the second half will be just as productive? The only judgments we can make are intuitive and qualitative."

Probably the biggest complicating factor is the inability to measure the contribution that research makes to over-all corporate performance.

A popular technique is to tally up the income from a project and attribute that to research. Says E. Duer Reeves, executive vice-president of Esso Standard Oil, "Modern industrial research is only a part of an integrated company effort. Trying to measure its effectiveness by how much the firm makes, or how many new products are put on the market, is like giving a football quarterback all the credit every time his team scores a touchdown."

James L. Lawson, manager of electron-physics research for General Electric's Research Laboratory, puts the same thought in these words, "Research is the head of the parade of a whole series of functions, including purchasing, engineering, production, sales. We can get the cash flow for a given project generated by the entire series with careful bookkeeping. But we can't tell what each member contributes simply from the cash flow statement. We can tell only what each

member spent." He notes that researchers often act in a consulting capacity for other company departments. This may be one of the most valuable outputs of a research department. He feels that a well-recognized research department presents a favorable image to customers and the public.

Since it isn't yet possible to measure these contributions, Lawson concludes, "Formulas, cash-flow analysis or other means of measuring research can be very helpful, if they're used carefully. If not, they can do more harm than good."

TWO ATTACKS ON THE PROBLEM

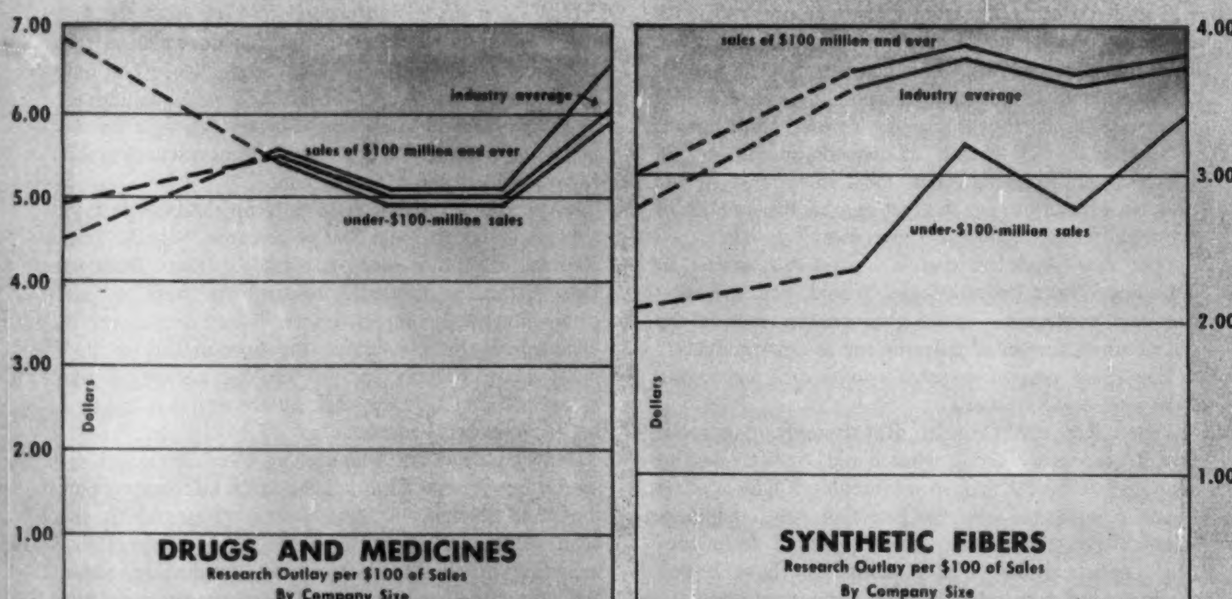
One potentially significant attack on the problem of measuring research efficiency is being launched for the National Science Foundation by Case Institute (Cleveland). The Operations Research group at Case proposes a three-phase study. Phase one deals with the development of an analytical model explaining how the performance of a firm is affected by its research and development activity. Phase two will extend this theory to an industry. (The chemical industry is the target.) Finally, the methods will be extended to the national economy, seeking to uncover ways that research and development activities in one industry affect—and are affected by—those of others.

Phase one, already under way, should be completed sometime this year. One of the first steps is to find a suitable definition of a company's performance. The Case workers point out that several yardsticks are employed. By examining data of several chemical companies over a period of years, they will determine whether there is correlation between the various measures of performance. If there is found to be good correlation, any one measure could be employed. If not, the group will have to develop different measures to determine which one—when used in the theory developed—will yield the most reliable results.

The model it hopes to devise will take into account the various corporate components (research and development, sales, purchasing, etc.) and the uncontrollable functions that affect a company's performance. The latter are of three types: (1) general economic (national employment, price levels, availability of credit, etc.); (2) competitive (pricing, advertising and other activities of competitors); (3) internal (operations—e.g., organizational structure, productivity, current share of the market—not involved in a company's budget).

After the model is developed, the Case OR workers propose to develop computational procedures to enable corporate management to arrive at a budget

Research by the big spenders—how it varies with company size



that will foster optimum performance. They also plan to develop procedures for detecting changes in the uncontrollable variables, adjusting the budget in the light of those changes.

Discount and Return: John C. Fisher of General Electric's Research Laboratory has taken an entirely different approach to a means of measuring research. To fully appreciate Fisher's work, you must have a clear concept of cash flow, discounted cash flow and equivalent return:

Cash flow is the change in a firm's liquid assets resulting from a given undertaking. Fisher likens liquid assets to a cash pool that is the source of all payments by the firm and the reservoir for all payments to the company.

Into this pool goes income (from sales, etc.). Out of it come payment for materials, taxes, maintenance, dividends, new facilities, establishment of new businesses and other purposes. At its start, each project takes money out of the pool and, if successful, more than repays it later. The difference between what it takes out and what it puts back is the cash flow.

All pertinent aspects of the business must be considered in cash-flow calculation of any project. Example: the possibility of loss of sales on superseded products.

Discounted cash flow recognizes that money not invested in a project would not remain idle, but would be invested elsewhere and earn compound interest. Imagine, for example, a project that would cost $1,000 this year and would repay $2,000 10 years from now. At a discount value of 5%, the discounted value of the $2,000 today would be $1,228. Put another way, $1,228 earning compound interest at 5%/year would grow to $2,000 in 10 years.

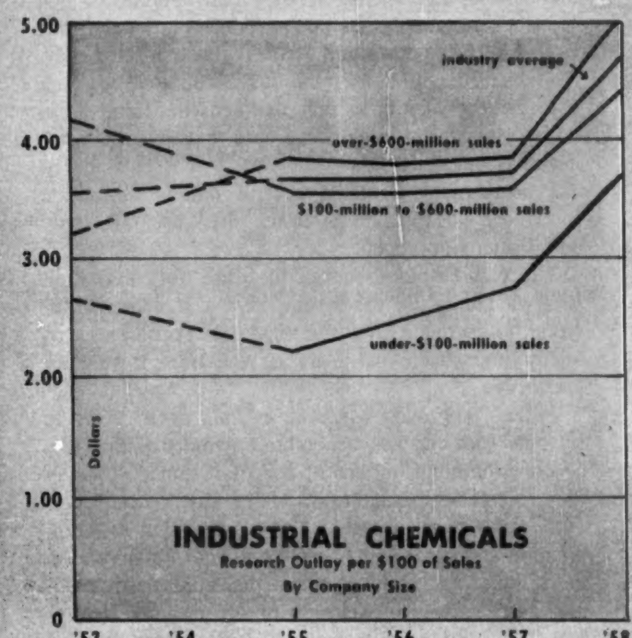
Thus, if the project were carried through, it would have a discount value of +$228. Had the discount rate been 10%, the discounted value of the $2,000 would be $771. Under those conditions, the discount value of the project would be —$229.

To find the discounted value of a series of transactions, simply add up the discounted value of the components, discounted to the same reference date.

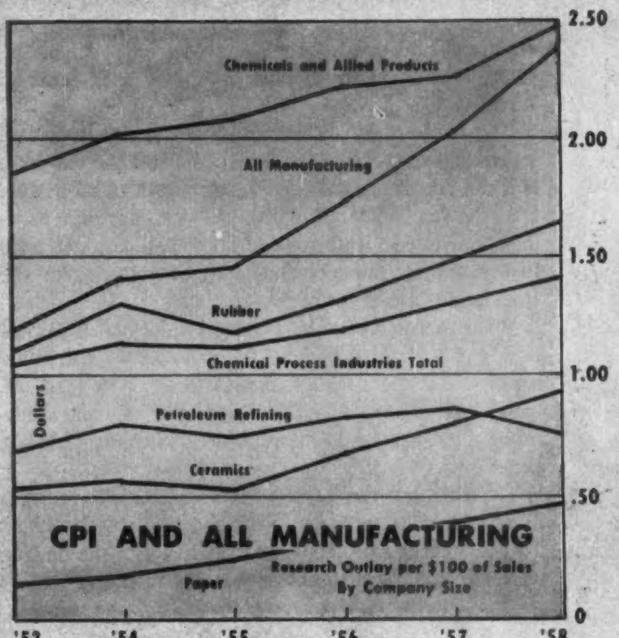
Equivalent return is the discount rate that makes the discount value zero. In the example above, for instance, the equivalent rate of the $1,000 (that would return $2,000 in 10 years) is 7.2%; at a discount rate of 7.2%, the discount value of $2,000 is $1,000.

Setting the Standard: Fisher has worked up an argument that the profitability criterion for industrial management is an equivalent return of about 6% after taxes. Any project showing less of an equivalent return

and how it compares with the outlays of other processors



Source: McGraw-Hill Dept. of Economics.



Source: McGraw-Hill Dept. of Economics.

'Is each product modification counted as a separate new product—for purposes of measuring productivity?'

should be rejected. Any that shows a higher return can be done profitably.

The essence of his argument is that, since 1870, stocks have sold to yield an average dividend of 5.4% a year, and price and dividends together have grown about 3% a year. The average stockholder, Fisher feels, pays approximately 50% of his income in taxes. So the average equivalent return after taxes from stock is 5.7% (50% of 5.4%, plus 3% growth). The minimum-category stockholder paying 20% of his income, would get an equivalent return after taxes of 7.3% (80% of 5.4% plus 3%).

The corporation, Fisher reasons, can either declare a dividend to the stockholders or reinvest the earnings. If it can get an after-tax equivalent return of more than 6%, the stockholder would do better to have the earnings reinvested. If the corporation can not get 6%, Fisher argues, the money should be returned to the stockholder in the form of dividends.

What to Do About It: Having established his criterion, Fisher then turned to the problem of determining whether the research budget is large enough (or too large) and whether the research managers are rating their projects in the right order of priority. What he proposes* is this:

The research managers would list all their projects in order of descending priority. On the bottom of the list goes the first project they would drop if the budget were cut; immediately above that, the next, etc.

This would be done every year and the list put away. A careful cash-flow analysis would be kept on all the listed projects. Then, after a period of time, say 10 years, the list would be taken out and divided into three parts. The top third would include the highest-priority projects, the bottom group, the lowest-priority.

With a discounted cash flow for each project, it would be possible to calculate the average equivalent return on each of the three groups. And that, as Fisher sees it, would give management the insight it needs.

For example, if the top group showed an equivalent return of 40%, the second group 30% and the third, 20%, it would know that research management was appraising its projects in the correct order. More than that, it would be logical to expect that—if there were another group—the equivalent return might be in the neighborhod of 10%. Using 6% as his guide, Fisher concludes the budget should be increased.

On the other hand, if the returns were 40%, 20% and 10%, management would know that, although the research administrators were rating their projects properly, the chances are the budget could not be expanded profitably. If the last group showed an equivalent return of 5% or less, the budget should be pared.

What if the lowest-priority groups showed the same —or higher—equivalent return as the highest group? "I don't think that would happen," says Fisher. "I have enough faith in modern research managers to be convinced that their appraisals of projects are sound. But if it should happen that way, you'd know that there was something wrong with their approach."

Fisher admittedly has not introduced any new principles into the measurement of research efficiency. His chief contribution is the suggestion that research management identify its marginal activities in advance. Also significant are the means he proposes for measuring marginal activities.

Proceed with Caution: Several points of caution should be observed in assessing the Case OR study and Fisher's approach.

The very ambitiousness of the Case work may limit its applicability, for the development of a mathematical model to correlate all the intricate relationships seems highly improbable—at least, at the present state of knowledge.

Fisher's approach will take as long as 10 years to try out. Also, he has deliberately avoided taking into account the contributions of corporate functions other than research—the main goal of the Case study. Moreover, some people question the soundness of his combination statistical and review approach. Possibly even more important, a management that emphasizes cash-flow projects to the exclusion of others could shortly find itself running an advanced development lab and not doing research at all.

* Fisher will publish two papers on this work in "Transactions IRE, Professional Group on Engineering Management."

The merit of Fisher's work lies in its being a much-needed fresh approach. It may turn out to be a complement to judgment, certainly not a substitute for it.

THE MAGIC NUMBERS

There have been a number of attempts to develop formulas for evaluating alternative research projects. Ralph Manley, laboratory director of General Mills, and Fred Olsen, former vice-president (now retired) of research for Olin Mathieson, each has worked up equations (*CW, April 9, '55, p. 72*).

Manley tried to relate the non-tax-deductible portion of research to sales volume; acceptable minimum net profits after taxes as a percent of sales; plant investment; working capital; and research and development costs before taxes.

Olsen postulated an "index of return," which would be equal to the estimated value of research, if it succeeds, multiplied by the probability of success divided by the estimated cost of research.

More recently, Carl Pacifico, vice-president of American Alcolac, has worked up a formula that has attracted considerable attention (*see p. 36*). Similar to Olsen's, Pacifico's idea takes into account both the technical and commercial risks and the projected savings over the estimated life of the project. His "project number" is the ratio of estimated savings to estimated costs, multiplied by a risk factor.

The American Alcolac method has limitations. It does not, for example, tell anything about priority of various projects. It might be assumed, for instance, that the higher the project number, the higher the priority it should have. "But," says Pacifico, "if the money for a plant is not available, the project would be deferred, regardless of its project number."

The project number does not distinguish big projects from small ones. Nor does it differentiate between a small project with assured success and a large one with only a slim chance of success.

To compensate for this deficiency, Pacifico suggests that a small company desiring to minimize risk could use a factor with the risk term. Object: to give high project numbers to proposals involving small risks. His idea: substitute the square of risk for the risk term.

Similarly, he feels that a company might want to favor projects that yield a return over a short span. In that case, the square root of life can be used instead of life.

Check, Double Check: Ralph Burgess, American Cyanamid economist, proposes a variation on the American Alcolac formula. He would incorporate a discounted value of the savings over a period of their life. In practice, this could be done by substituting a factor (which can be obtained from a table showing the net present worth of an annuity) for life. This would give a somewhat more realistic meaning to the project number.

But, for comparison purposes, Pacifico's idea of substituting the square root of life for life would amply compensate for neglecting a reasonable discounted value of the savings.

Burgess has also suggested* a checklist as an alternative to a formula in evaluating research projects. He feels that each proposal should be subjected to rigid tests to determine: feasibility from an engineering and manufacturing viewpoint; marketability—if it's a new product—by consideration of distribution aspects and the customer preference; potential profitability in the light of projected sales, price, production, cost, availability and cost of capital.

To that end, he has drafted a checklist (*see p. 36*) that enumerates some 50 qualitative factors to be considered in evaluating a research project. The list provides separate columns for the various departments making the judgments.

Profit Profile: A variation of a checklist, a profile chart, has been used successfully at W. R. Grace, ac-

'In basic research, results are usually heavily weighted in favor of the researcher's own specialty'

* In AMA's Report No. 3, "Planning Ahead for Profits."

THE COST OF BASIC RESEARCH—IN MONEY AND MEN

Industry	Publications		Cost Total*	Cost Per Paper	Scientists Total**	Scientists Per Paper
Chemical	833	1,457	$37.8	$26,000	1,990	1.37
Pharmaceutical[1]	624					
Electrical	501		$19.1	$38,000	660	1.32
Petroleum	384		$11.1	$29,000	480	1.25
Other[3]	686[2]		$81.7	$120,000	2,370	3.45
Total	3,028		$149.7		5,500	

Source: J. C. Fisher of General Electric Research Lab. * Million dollars; according to NSF survey. ** derived from NSF figures on basic research costs and average cost of research and development per scientist or engineer. (1) Including American Cyanamid's Lederle and Olin Mathieson's Squibb. (2) Not including papers on basic work in engineering, of particular importance to aircraft and instrument companies. (3) Including primary metals, food, transportation equipment, fabricated metals, instruments, paper, stone, clay and glass.

cording to T. T. Miller, president of the Polymer Chemicals Division.

In this method, a list of 39 factors is drawn up. Each factor is rated: very good, good, average, poor or very poor. Ratings for the individual factors are connected by a profile line. After all the factors are rated, the entire profile of a new product, for example, can be examined.

A large number of poor or very poor ratings shows up immediately. If the profile hovers near the average line, Miller says, the project should be shelved, at least until more promising ones are exhausted.

For Grace, the profile chart was a way out of the problem of rapidly screening a multitude of proposals; one division was barraged with ideas, when it deliberately sought as many as it could get.

"It was successful enough," Miller reports, "to justify our feeling that the method—with modifications, perhaps—can be used in almost any similar situation, faced by another division or by a totally independent company.

Need for Timing: Whether or not they use a formula, checklist or profile chart, chemical companies now consider a running economic evaluation of research a must.

Monsanto, for instance, has learned how to program such evaluations on a computer (*CW, June 7, '58, p. 54*). Armour Chemical's McCorkle says that too many budget restrictions would result in "having more accountants than chemists in the laboratories." But he does state that the decision to continue or abandon a project is always based on economics—how much the project is costing, the anticipated benefits, the sales potential. Dow critically reviews projects as they move from one stage to another.

Whatever the system, chances are that an appraisal at a very early stage of development would probably end up wide of the mark. It isn't too important then, because projects don't start to chew up money at this stage. But it is vital that a sound economic evaluation be made before the pilot stage is reached, because that's when the money goes—often at an alarming rate. And from that follows one of the few generalizations that can be made on the use of formulas or other aids: the closer the project is to commercialization, the more valuable these aids become.

HOW MUCH BASIC RESEARCH?

This, of course, leaves the question of basic research wide open.

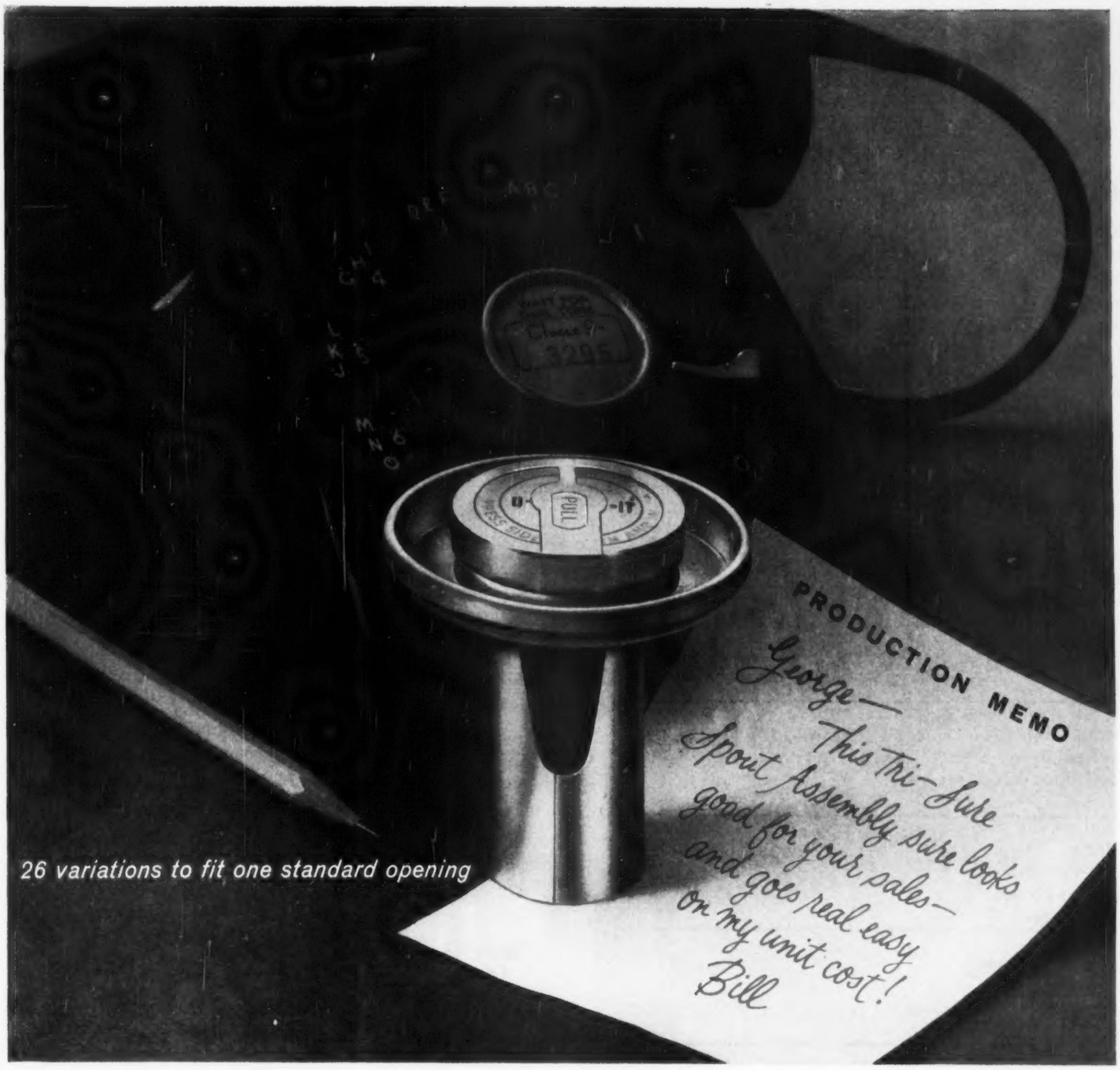
The first difficulty encountered in evaluating basic research is the disagreement on a definition for it. The popular one: it is scientific inquiry done without the goal of immediate commercial application.

Trouble with this definition (and variations), as Guy Suits, vice-president and director of research for GE, sees it: "Curiosity provides ample motivation for the scientist, but it is not a sufficient motive for the supporter of research." Thus, he concludes, the question of why you do it tends only to confuse the definition of basic research. He prefers that motivation—or lack of it—be left out altogether.

Accordingly, he prefers to characterize basic research simply as the "process of learning new scientific knowledge." In fact, at GE, researchers divide research into "learning work" and "applying work."

Suits also takes issue with contentions that basic research cannot be planned. He concedes that it's not possible to predict when something will be found or what it will be. But he feels that it's possible to sketch the probable outlines and timing of this progress, its probable impact on industrial technology.

Even in "basic" work, Suits feels that a great deal can be done by research management to plan the organization and the operation of its programs to attain



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WHO PUBLISHES BASIC RESEARCH PAPERS AND HOW MANY

	Company	Papers
1.	General Electric	170
2.	Bell Telephone Laboratories	134
3.	Du Pont	121
4.	American Cyanamid*	107
5.	Merck	90
6.	Eastman Kodak	81
7.	Shell Oil	73
8.	Monsanto Chemical	65
9.	Union Carbide	63
10.	Dow Chemical	58
11.	Westinghouse	57
12.	Eli Lilly	54
13.	Standard Oil (Indiana)	48
14.	Rohm & Haas	45
15.	Upjohn	44
16.	Burroughs, Wellcome	35
17.	Radio Corp. of America	35
18.	Sylvania Electric	33
19.	Abbott Laboratories	32
20.	Parke, Davis	32
21.	Phillips Petroleum	31
22.	Socony Mobil	31
23.	Sterling Drug	31
24.	Ciba Pharmaceutical	28
25.	U.S. Steel	28
26.	Standard Oil (California)	24
27.	Armour	23
28.	Olin Mathieson**	23
29.	Hercules Powder	22
30.	Chas. Pfizer	22
31.	Schering	22
32.	General Aniline	21
33.	Humble Oil	21
34.	North American Aviation	21
35.	Ethyl	20
36.	General Mills	19
37.	Hoffmann-La Roche	19
38.	B. F. Goodrich	18
39.	Gulf Oil	18
40.	Aluminum Co. of America	17
41.	U.S. Rubber	16
42.	American Home Products	15
43.	G. D. Searle	15
44.	Sun Oil	15
45.	Procter & Gamble	14
46.	Sperry-Rand	14
47.	Blockson Chemical***	13
48.	Esso Research and Engineering	13
49.	General Motors	13
50.	Smith Kline & French Laboratories	13
51.	Atlantic Refining	12
52.	Goodyear Tire	12
53.	Irwin, Neisler	12
54.	Allied Chemical	11
55.	Bristol-Myers	11
56.	Ford Motor	11
57.	Minnesota Mining and Manufacturing	11
58.	Continental Oil	10
59.	National Lead	10

*Including 60 papers from Lederle.
**Including 12 papers from Squibb.
***Now a part of Olin Mathieson.

Sources: J. C. Fisher of General Electric Research Lab, who counted papers from 1955 Chemical Abstracts, 1954 issues of the Bell System Technical Journal and five Institute of Radio Engineers publications. It does not include papers from consulting firms, commercial labs and a few labs operated by private companies for the government.

the objectives that will have the desired impact on technology.

To support his point, he asks: "How many metallurgists have you heard of who, in the course of their research, discovered a new antibiotic drug? Or how many solid-state physicists have discovered a new polymer synthesis?"

His conclusion: results of research are heavily weighted in favor of the investigator's specialty.

Who Does Basic Research? The definitive word on the scope of the industrial basic research effort in the U.S. is the National Science Foundation's survey (NSF-56-16) in '53. It found that industry employed about 5,500 scientists to do $150 million worth of basic research, more than half of it by the chemical, petroleum, electrical and aircraft industries.

GE's Fisher has worked out some relationships that may prove helpful in evaluating the "paper product" of basic research. His full paper will be published in the June 19 issue of *Science*.

Feeling that published scientific papers would be an accurate reflection of the basic research effort, he went through *Chemical Abstracts* (covering the period of the NSF survey), and also studied appropriate scientific journals to survey work in electron physics that would not normally be carried in *Chemical Abstracts*. As Fisher sees it, the only industrially important sciences not covered there are the engineering fields.

Out of 100,000 abstracts, Fisher found 3,000 authored by employees of industrial concerns. About 500 companies were represented. But only 59 had 10 or more papers and they accounted for two-thirds of the total (*see table, left*).

Fisher counted up the number of publications by industry and compared totals with the number of scientists engaged in basic research in each industry, as reported by NSF. Excluding those industries that accounted for only 20% of the published papers, he found a surprisingly good correlation (*see p. 44*).

Since NSF had also surveyed and reported the average cost of research per scientist or engineer, Fisher was also able to calculate the average cost per publishable paper produced.

In substance, Fisher found that an average 1.34 scientists in basic research produced a publishable paper every year.

This is an average, however, and does not reveal the existing wide variations in productivity of individual scientists. The cost per paper ranged from $26,000 for the chemical and pharmaceutical industry to $38,000 in the electrical field.

If his calculations are valid, it would be possible to estimate the number of scientists engaged in basic re-

search for any company simply by counting the papers, multiplying by 1.34. Says Fisher, "Confidential information from some of the companies suggests surprisingly good results, and the method perhaps may be relied upon to an average accuracy of 20% or so."

FOUR RULES TO FOLLOW

Not every company, of course, sets the same type of objectives for its research. Esso's Duer Reeves has defined research as "an organized effort on the part of the company to provide itself with the technology it needs for its present and future operations." For any company agreeing with that definition, the measurement of research is simplified by the following four rules:

Rule 1. Make research an integrated part of the company's operations.

Before the research department can concern itself with supplying needed and anticipated technology, it must know what is required. And the department can do that only if it's closely integrated with the rest of the company.

Says Reeves, "Once the company and research organization have analyzed the need for new technology, the question is no longer whether enough research is being done; the question becomes specific and quantitative—it asks whether or not particular objectives are being achieved."

A corollary of the first rule: make sure that the top research man in the company is a working member of the executive team.

Rule 2. At an early stage of development, use formulas, check lists, cash-flow analyses and other yardsticks as guides only.

Some accurate economic appraisal is an absolute necessity before the pilot-plant stage is reached. Piloting is an expensive business, and no company can afford many speculative pilot operations.

The formulas and other systems can be helpful in forming judgments even at an early stage—if not relied on exclusively. "I am greatly encouraged," Suits says, "by the usefulness of project case studies. They have clearly justified the effort involved."

Rule 3. Don't hesitate to accept the intuitive, qualitative judgment of an experienced research manager.

Says GE's Lawson: "With a large group of scientists, you can't get universal agreement on a detailed ranking for a group of research projects. But you can get universal agreement on what is 'good science' and what is 'bad science.' It's the same way with scientists. Poll a group of them and you'll get universal agreement on who are the top scientists and who are the poor ones."

While you will find some divergence of opinion on the middle group, Lawson admits, "You'll get universal agreement that they belong in the middle."

Rule 4. Apply the same performance to the supporting services of research that you apply to any other corporate function.

Reeves estimates that the truly creative work in a research effort, when shorn of all its supporting services, accounts for no more than 10% of the total expenditure. He sees no reason why the remaining 90% can't be examined with a view toward greater efficiency.

In supporting roles, he places: construction and maintenance of physical facilities; the work of mechanics, operators, laboratory assistants, stenographers, file clerks and others; development programs involving the construction and operation of pilot plants and the planning of these programs; engineering field services; and management activities such as the establishment of proper organization, maintenance of morale, salary administration and training programs.

Even the most scrupulous observation of any set of rules, however, won't necessarily simplify the measurement of research efficiency. But the thought and effort being devoted to the subject can hardly fail to produce better tools for management. And, in this era of scientific management, it is eminently fitting that research executives are striving for more scientific management of science.

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LYTRON* 822
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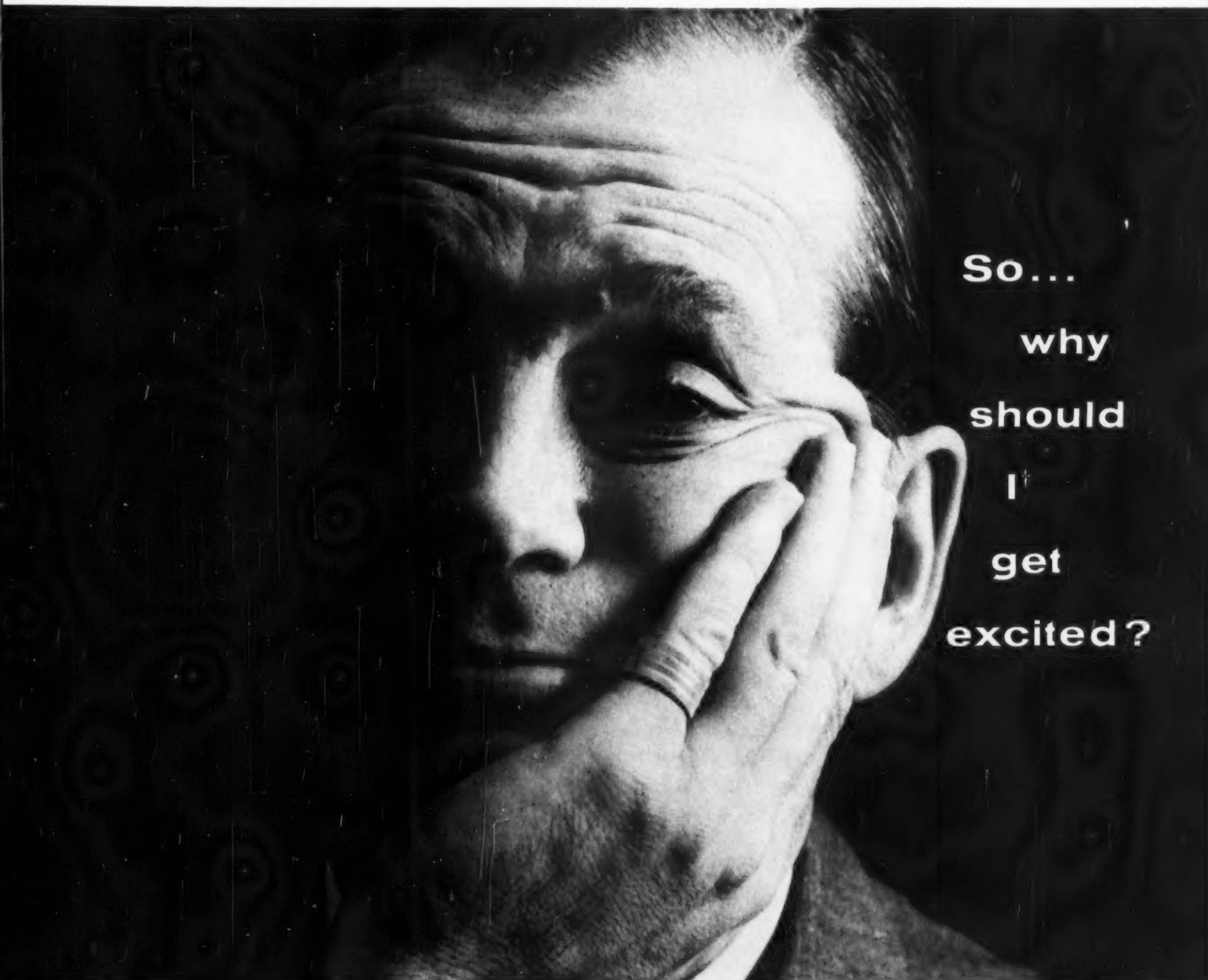


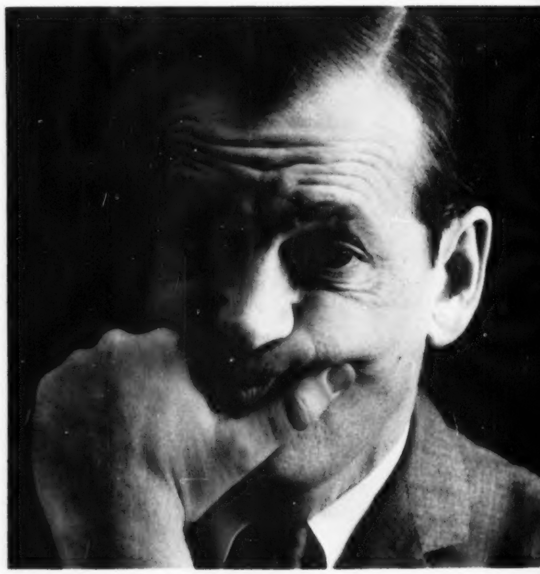
*LYTRON: Reg. U. S. Pat. Off.

†Compounder of floor polishes, clear and pigmented protective coatings, inks, adhesives, electrical component coatings, cosmetics, or toiletries.

what is Lytron 822 Resin?

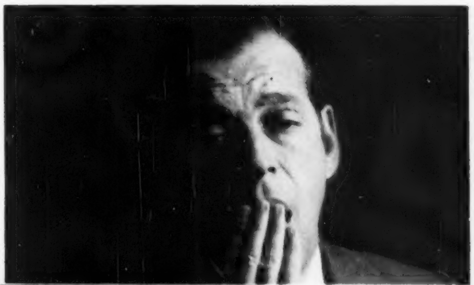
A polyelectrolyte resin, free-flowing, powdered carboxyl containing styrene copolymer.

PHYSICAL CONSTANTS			SOLUBILITY	
Total Solids:		100%	**Soluble in:**	ammonia
Specific Gravity:		1.14–1.16	ethyl acetate	xylol/butanol
Dielectric Constant:		3.29 } at 1 mc	acetone	
Dissipation Factor:		0.02991 } at 1 mc	methyl ethyl ketone	**Insoluble in:**
Acid Number:	approx.	190	II-B alcohol	hexane
Equivalent Weight:	approx.	295	alkalies	toluene
Stability of Solid Resin:		No change on storage under normal conditions.		



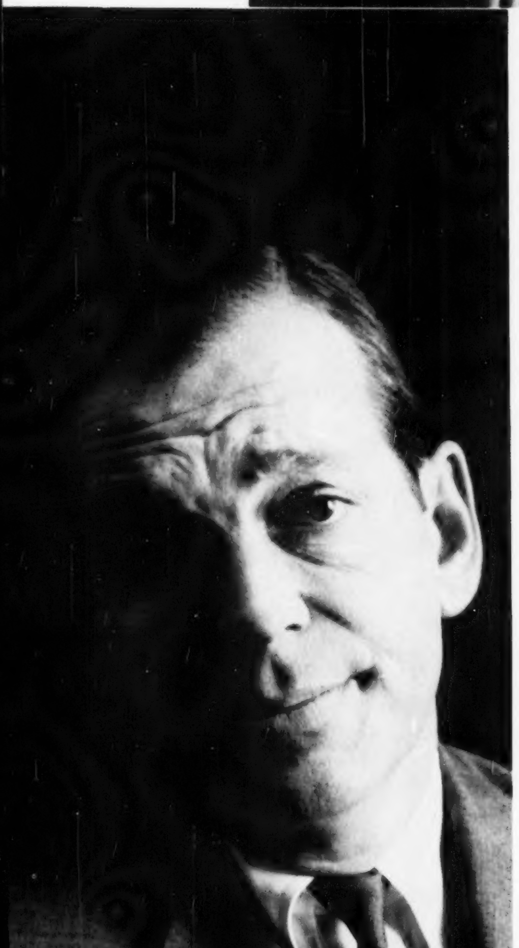
good for what?

Lytron 822 Resin is recommended for use as a protective colloid, film forming vehicle, dispersing agent, pigment binder, emulsifier. It can also be a reactive component in water and organic soluble thermosetting coatings. Excellent in combination with starch and dextrin for adhesives.



what's so special?

Ease of solution in alkaline or organic solvent systems. Relatively low molecular weight qualifies Lytron 822 for applications heretofore restricted by the high solution viscosities characteristic of this type compound. Compatibility with a wide range of natural and synthetic resins. Clear continuous films cast from both alkaline or organic solutions of Lytron 822 resins. Every product will have good color and color retention.



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Take compatibility. In the unneutralized acid form, Lytron 822 resins are compatible with polyvinyl butyral and many alcohol soluble resins. Partial compatibility (low concentrations) is achieved with nitrocellulose. Compatible with ammoniacal solutions of Lytron 822 resins: rosin derivatives, (hydrogenated rosin) unsaturated oil acids, polyhydroxy compounds and their water soluble derivatives (methoxy polyglycols, polyglycols, polyglycol mono-ethers) urea and melamine resins.

Partial compatibility results when these materials are added to ammoniacal solutions of Lytron 822 resins: polystyrene, styrene-butadiene, copolymers, polyvinyl acetate, acrylic, waxes, starch, casein, and soya protein.

Note: LYTRON 822 has exhibited considerable promise as the alkali soluble resin in self polishing resin emulsion and wax emulsion floor dressings. LYTRON 822 is easy to compound, compatible with currently favored constituents in floor polishes and contributes to the stability and good color of the emulsion. When used with other constituents like polystyrene latex and polyethylene wax, the formulator can prepare a polish based entirely on uniform synthetic materials. These polishes perform as well as polishes based on natural resins—but with improved color and stability of supply and price of the raw materials.

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WHEN INSTRUMENTS BREAK DOWN . . .

Repair	Replace
If present instrument will do the job	If a process requires a better instrument
If repairs are mainly routine servicing	If instrument parts are no longer available
If new parts will improve performance	If new instrument is of an improved design
If cost of replacing instrument is high	If repair cost approaches replacement cost

Wanted: Guide to Instrument Maintenance

When plant instruments fail, the above chart shows, there are a host of reasons why some are repaired, others replaced. But choosing whether to repair or replace isn't always clear-cut. Said an instrument engineer, faced with that choice this week: "There are no simple formulas. We would certainly welcome one."

Behind this need for a simple, workable replace-or-repair formula is the upsurge in instrumentation that has more than doubled investments over the past few years at many plants. At Du Pont, for example, instrument investment has jumped from \$60 million in '50 to more than \$100 million in '58 — up to 10% of plant investment. The Chambers Works has about 15,000 major instruments.

Procedures that were satisfactory at one time have quickly become outmoded. For example, at American Potash & Chemical Corp.'s Trona operations, starting in the early '30s, the total number of instruments actually replaced up to '50 was less than a dozen. Some others had been completely retired, while still others were repaired several times a month. This experience had convinced Trona management that 20 years was the approximate useful instrument life, although retirement wasn't automatic.

But now, Trona's 20-year rule has gone by the boards. Some instruments less than 10 years old have become less serviceable than others that are more than 20 years old, according to Cliff Gest, instrument engineer at Trona. "Improvement of our electrical and air-supply systems and relocation of instruments from field locations to control centers have changed our conditions to such an extent we no longer feel we can base our retirement and parts-replacement policies on prior experience," says Gest.

Retirement Formula: One cement producer advances the rule of thumb that an instrument should be replaced when outlays for repair time plus parts in one year equal 50% of the original cost of the instrument. Routine servicing, such as cleaning, battery replacement and calibration, is not included in the 50% figure.

But others point out shortcomings of such a rule. "We often spend more than this for repairs during the first year of an instrument's life. Maintenance costs then drop considerably in the next few years," says an instrument engineer.

Vince Riggio, USI's instrument engineer, claims that most instrument maintenance is, in itself, not costly. But it is time-consuming — for several reasons. One estimate: only about one-third of the time is spent in actually making repairs; the other two-thirds is spent in making preparations, traveling to the area, etc.

Cost System: A good cost-accounting system is stressed by most instrument engineers as the first step in arriving at any workable repair-or-replace formula. Some plants have difficulty separating instrument maintenance from regular mechanical maintenance; others have difficulty separating actual productive time from total time that is charged to maintenance.

"A good cost-accounting system offers double control. It not only tells what instrument repairs cost but also makes possible a comparison between instrument mechanics. The efficient mechanics can be separated from those who aren't," says another engineer in a Midwest plant.

Added Expense: Actual repair costs tell only part of the story. Instrument downtime is expensive in other ways. But again, lost production varies considerably between plants and processes. For example, one company estimates that shutdown of one process costs \$600/hour, while another process shutdown costs \$5,000/hour.

Reasons for lost production time aren't always easily pinned down. Gest points out that if an extra man must be added to a crew for a period of time the cost is easily evaluated. But when a process upset occurs it is often difficult to separate instrument fault from operator misjudgment.

To avoid process trouble due to misleading instrument readings, some firms duplicate measurement and control systems in critical processes. In many plants, the instrument mechanic's day begins as it does at Buckeye Cellulose's Foley, Fla., plant — in each of the process control centers where each instrument is checked out. No instrument is assumed to be functioning properly unless it has been checked out by the center's instrument mechanic.

What Is Obsolescence? One of the reasons for replacing instruments is obsolescence. M. W. Adcock, instrument engineer at Union Oil's Los Angeles refinery, cites three categories of obsolescence: (1) the instrument is no longer manufactured and parts aren't available, (2) the instrument has been superseded by models with improved qualities, (3) the process requirements

have been upped to the point where the instrument can no longer fulfill them.

Even when an instrument is no longer being manufactured, most instrument makers offer parts for some time. But eventually the time comes when parts must be custom made. This makes repairs difficult and expensive. Nevertheless, Adcock believes, some of these instruments can still be of useful, if limited, service.

Another company feels that an instrument maker has a responsibility to make repair parts available on an off-the-shelf basis for at least 15 years after an instrument has been purchased. It bases its new instrument purchases on an instrument maker's previous ability to supply parts during this time.

Adcock classes an instrument that has been superseded by improved models as "moderately obsolete." Plant and process improvements gradually reduce their number. Gest puts it this way: "What was quite satisfactory in the way of control a few years ago is not always good enough today. Some replacements can be justified on this basis alone."

Gest adds that sometimes instruments can be modified to meet new performance demands rather than be replaced completely.

Not by Obsolescence Alone: Obsolescence alone is seldom sufficient justification for replacement, according to Adcock. Two other incentives that make replacement profitable: improved operating performance and reduced maintenance costs. In fact, in some cases (e.g., when rapid depreciation is caused by severe operating conditions, or when an instrument has been misapplied), obsolescence is not the primary factor at all.

There are so many factors involved that virtually all potential instrument replacements must be decided upon individually. But one factor that helps in decision-making is that about 80% of the instruments now in service are standard equipment and have been in common use for some time. Only about 20% are special instruments such as process-stream analyzers, special pH or specific-gravity indicators.

Some firms weigh amortization and book value heavily, others replace at any time because instrument amortization is rapid. But the day is fast approaching when there will be little difference between practices. Adcock sums it up this way: in the past, many entire plants have been replaced after a short time, and that has often automatically included instrument replacement. But the practice of fast plant write-offs is passing. Modernization is becoming a greater factor, and instrumentation is one of the keys in modernization.

Because of these changes, instrumentation obsolescence and replacement will require more careful consideration. Any methods that can simplify procedures are certain to be welcome.

EQUIPMENT

Coded Control Valves: The Manatrol Corp. (2108 Payne Ave., Cleveland 14) is out with a new control valve that uses color coding to eliminate errors in setting. With each turn of the valve, a different color shows on the valve stem. The valve also has numerical graduations for less than full-turn settings. Color-flow valves are available in five sizes ranging from ⅛ to ¾ in.

•

Small-Flow Measurement: Schutte and Koerting (Cornwells Heights, Pa.) is offering a new line of Purge rotameters for measurement and control of small liquid and gas flows. Capacities of largest units: 12 gal./hour of water and 70 cu.ft./hour of air at 10 psig. Major application: to prevent process fluid from entering the connecting pipes and sensing elements of instruments.

•

Explosionproof Motor: A water-to-air, heat-exchanger system is featured in an explosionproof motor marketed by General Electric Co.'s direct-current motor and generator department (Erie, Pa.). The motor is a new addition to the company's Kinamatic line, is rated at 40-150 hp. at speeds up to 6,000 rpm. The new heat exchanger system is said to be more efficient than conventional air-to-air systems, allows a substantial reduction in the size of the motor.

•

Thickness Gauge: A nuclear thickness gauge for measuring continuous-sheet material as thin as two-millionths of an inch is a new product of Radiation Counter Laboratories,

Inc. (Nucleonic Park, Skokie, Ill.). Thicknesses of protective coatings are measured to an accuracy of 0.01%.

•

High-Pressure Pipe Unions: Special Screw Products Co. (Bedford, O.) has a new line of corrosion-resistant, high-pressure pipe unions. The units, called Koncentrik Pipe Unions, are made from stainless steel, have a Teflon inner seal, are rated from 2,000 to 6,000 psi. The unions are available for pipe sizes from ⅛ to 2 in.

•

Package Controls: Assembly Products, Inc. (Chesterland, O.) has a new line of miniature package controls for use with most of the standard circuits built around API meter-relays. The small size is said to be a limitation only in the most complicated meter-relay circuits and where loads of over 2 amps. are used.

•

Low-Chrome Pipe: Large-diameter, seamless low-chrome pipe is now available from Phoenix Steel Tube Division of Phoenix Steel Corp. (Phoenixville, Pa.). Diameters range from 8⅝ in. to 16 in., wall thicknesses from ⅜ in. to 3 in. Phoenix also claims economies in low-chrome pipe fabrication methods.

•

Metering Pump: Walter H. Eagan Co. (2336 Fairmount Ave., Philadelphia 30) is now offering the CPI a new metering pump for feeding 1.5-108 gal./hour of corrosive or non-corrosive liquids. The new pump withstands pressures up to 625 psi., can be specially constructed to withstand several thousand psi.

•

Centrifugal and Reciprocal Pumps: Two firms are now marketing new centrifugal and reciprocating pumps.

U. S. Steel Corp.'s Oil Well Supply Division (Braddock, Pa.) has added two models to its Wilson-Snyder line. One is a 500-hp. centrifugal pump that can deliver 12,000 gal./minute to a 150-ft. head. The other, called the 246-P, is a 28.5-hp. general-service reciprocating pump with a capacity of 126 gal./minute.

G&H Products Corp. (Kenosha, Wis.) has a new line of centrifugal pumps that features interchangeable pump heads. The line includes a wide range of capacities, a common housing that allows flexibility in changing from one capacity to another.

SOLVING THE SMALL-ORDER PROBLEM

How can orders for small quantities of chemical products be handled profitably?

ANSWERS	ADVANTAGES	DISADVANTAGES
1. Establish a "minimum order" requirement that will cover basic costs.	Gives salesmen and customers clear rule to follow.	Can create customer relation problems where account buys other items in bulk.
2. Have salesmen discourage—on informal basis—placement of small orders.	Provides flexibility in meeting special situations.	Not systematic, hard to control.
3. Set less-carload-lot prices sharply above bulk prices.	Guarantees sales volumes will cover costs, ensures availability to customers.	Customers complain of higher prices.
4. Insist that customers place small orders through distributor.	Improves distributor-supplier relationships.	Customers sometimes must pay higher prices.
5. Handle orders as free samples.	Sometimes cheaper than billing.	Not effective when accounts reorder repeatedly.

How to Keep a Lid on Small-Order Costs

Steadily rising sales-order handling costs have again turned the spotlight on the problem of how to handle small orders profitably. A few months ago, the price differential between less-than-carload orders and bulk orders was substantially boosted for a wide range of organics. Last week, a chemical producer told CW it will boost the differential between large and small orders of inorganics.

The latest measure, likely to be followed by others in the industry, is just one of the several answers to the small-order problem. Other companies, particularly those in the fine-chemicals field, have been trying minimum orders — i.e., a "floor" on orders, either by weight or by dollar volume. Also tried: referring customers with small purchases to local distributors, or treating the little orders as samples.

What plan is best for you? And how do you go about putting a particular procedure into effect? Here's industry comment on the situation, and some guideposts to setting up a plan.

Minimum Orders: One of the most popular practices is the minimum-order system. It's flexible—companies with such plans have had to make few changes in the past few years, because, as over-all price schedules change, the minimum-order volume rises if the plan is on a weight base.

If properly done, savings from minimum-order programs can be impressive. A New York-based chemical drug and specialty chemical firm that went over to the method two years ago reports it has handled 3,000 fewer orders in one division but did not lose an account or suffer a sales decline. Net savings at $8/order: $24,000.

As with all approaches to small-order handling, economic considerations are paramount in decisions to establish minimum-order limits. Included are elements such as paperwork, shipping charges and handling costs. Paperwork, for example, might cost a small specialty company as little as $2-$3; for some fine-chemicals firms the cost is in the $5-$10 range. And for industrial chemical makers, estimates range from $12 and $18 to $25-$35. Because the cost of order paperwork is largely the same whether the order is for 10 tons or 10 lbs., this figure offers a starting point with which to figure minimums.

Minimum Criteria: Establishing a minimum-order policy can be a simple or a complicated matter. As shown, in some cases it's merely a matter of determining the charge necessary to cover all costs and return a profit on a small order. Other companies, however, employ a highly systematic approach. An Eastern marketing director for a large fine-chemicals producer set his minimums by considering these factors:

- Nature of the product-line mix.
- Seasonal factors.
- Product value per unit weight.
- Container costs.
- Paperwork costs.
- Shipping and freight costs.
- Competitive practice.
- Demand for production-line time.

Generally, sales departments have

authority to set minimum-order specifications. A few firms, however, seek the views of production and traffic departments.

Pounds or Dollars? Both weight- and dollar-limit systems for establishing minimums find backers in the CPI. Dollar limits are more commonly set by fine-chemicals dealers who have a very wide range of products. Weight limits are preferred by industrial chemical sellers. In each case, the system is chosen to minimize costs.

Some firms using dollar minimums, however, shy away from flat limits; they prefer a dollar limit tailored to each product. One Midwestern producer, for example, justified this policy by pointing out the wide variation in individual product costs.

How Low? Dollar limits fluctuate by company; those using minimums geared to individual products set limits as low as $10. Others insist on much higher minimums; one Eastern company, for example, sets the limit at $200.

Industrial chemical makers using minimums lean to weight systems, although there are exceptions. Typical minimum is 1 ton—but some are carload-lot weights (about 40 tons).

An important variation in minimum-order systems arises from companies that set no formal limits but refuse to ship less than the amount its standard containers hold.

Customer Relations? Customers that chafe at minimums are known to almost all firms using minimum systems. Yet, serious customer relation problems aren't often encountered. A customer buying a small quantity of some item may transfer his business for bulk purchases of another item to another supplier. But if this danger exists, salesmen and sales managers show a flexible attitude. Standard rule: "Fill the order."

The latter situation points out what is perhaps the minimum-order plan's biggest problem: enforcement difficulty. If too many exceptions are made, a set policy soon becomes worthless. An Eastern specialty maker gets around the problem by refusing salesmen commissions on less-than-minimum orders. Although generalization is difficult, *CW* found little indication that chemical producers are more lenient on minimum orders when a mixed car or truckload is being shipped. And a Chicago-based firm lets a customer ship below the minimum on one item only, provided the dollar volume is still profitable.

Antiminimum: But some companies simply do not want to set minimum orders. Many large chemical producers — especially those headquartered in the East — set no formal minimums, take the position that no order should ever be refused if it's possible to fill it. Firms with this attitude often treat small orders as samples — hoping they won't face continuous repeat orders. Others control the situation by placing special premium charges (over and above the regular l.c.l.-bulk price differential) on exceptionally small orders.

To cover out-of-pocket order-handling costs, some companies resort to premium prices. On quantities less than the "standard pack," one fatty-acid processor sets a premium of 5-8¢/lb. And a rubber chemical maker adds a flat $1.50 for any order under 50 lbs. or 55 gal.

But even here, the purpose is to cover costs of order-handling at a profit — and not to eliminate the small-quantity sale. Producers are keenly aware that small orders are often a prelude to bulk sales.

Shipments to chain-type customers (national accounts) sometimes pose knotty problems. Although an order may be well over the minimum, a customer may request that it be broken for shipment into numerous locations. A Southeast specialty maker encounters this problem frequently, makes it a policy to refuse shipment. If the customer "is a good one," however, the producer sometimes meets the request.

Distributors Favored: Referral of the small-quantity order to a distributor is often used to dodge such high order costs. Distributors can handle the small order profitably because of their much lower overhead, and the fact that they can often sell many companies a wide range of chemicals. Yet, in some cases, it isn't always possible to shunt l.c.l. business to distributors — not all chemicals are suitable for wholesaler distribution.

Nevertheless, several large chemical distributors believe that they will be called upon to sell larger quantities than their traditional l.c.l. (About 23% of distributor volume now comes from bulk sales.) This view, however, is disputed by most companies responding in *CW*'s survey. Large buyers prefer, they report, to purchase directly from the producer. One company, however, bucked the consensus —told *CW* it was moving to distributors for bulk sales "where the economics warranted it."

But, in most cases, using a distributor means a higher cost for the consumer. And this leads to complaints: "It's natural to expect that a customer with a $40 requirement will be irritated if you send him to a distributor and he has to pay $60," said a New York sales manager.

This same sort of unfavorable reaction also faces the chemical maker whose small-order policy is to increase the price differential between l.c.l. and bulk quantities. But those favoring a differential gain friends in another area — the distributors that buy bulk and repackage.

Almost all approaches to small orders entail some drawbacks (*see chart, p. 57*). Yet, for many companies they prove valuable. Judicious use of minimums and price differentials can keep small orders manageable and profitable, and prepare both customer and supplier for the big "follow up" order.

DATA DIGEST

- **Acrylamide:** New annotated bibliography gives abstracts of recent literature on acrylamide, related chemical intermediates, fibers, physical studies, plastics, polymers and surface coatings. Petrochemicals Dept., American Cyanamid Co. (New York).
- **Data machines:** 8-page brochure (RT 8986) discusses use of common language tape and edge-punched card machines. Remington Rand (New York).
- **Surface coating:** New 4-page brochure gives application and test data on Kure-N-Seal, a coating for curing, sealing and dustproofing concrete surfaces. Building Products Division, L. Sonneborn Sons, Inc. (New York).
- **Neoprene sponge:** Folder suggests application of extruded closed-cell sponge in variety of sealing applications (doors, gaskets, etc.). Elastomer Chemicals Dept., Du Pont (Wilmington, Del.).
- **Lubrication:** Bulletin discusses lubrication of roller and silent chain drives. Sun Oil Co. (Philadelphia).

NEW PRODUCTS···NEW PLANT

VITEL* and VIDENE* by GOODYEAR PLANT by CATALYTIC

Vitel, a new polyester resin, and Videne, a new polyester laminating film, are now in commercial production at the Goodyear Point Pleasant Chemical Plant at Apple Grove, West Virginia.

Engineering, procurement and construction were the unit responsibility of Catalytic. Coordination and cooperation with the client were a necessity to complete this unique installation "On Time—On Budget."

The production of Vitel and Videne by Goodyear paves the way for many new applications in the textile, metal, wood, paper, packaging and related industries.

Thinking of new plants for new products? Consult CATALYTIC first.

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CW PHOTOS—L. CRAWFORD

Executives, scientists, educators share the stage at Rockefeller Institute, discuss basic research.

Spotlight on Basic Research's Big Problem

The biggest problem in basic research: finding enough money to encourage new projects and keep current ones active.

That matter was a prime concern of several hundred executives, educators and scientists last week, as they met at New York's Rockefeller Institute* to plan the course of basic research in the U.S.

The presence and comments of President Eisenhower placed additional urgency upon the several missions of the meeting, which included defining the status of basic research in the U.S. and formulating new ideas and concepts for improving basic research activities in industry and government and in private institutions.

All sciences were represented by both industrial and educational participants. The CPI provided several speakers, including Max Tishler, vice-president of Merck Sharp & Dohme; Isidor Rabi, Nobel Prize-winning biochemist; Crawford Greenewalt, president of Du Pont.

All of the participants came to the meeting with full realization that there's no single way to reorganize the approach to and boost the ultimate productivity of basic research.

More Money: James Killian, special assistant to the President, for science and technology, spoke first on the problem of finding additional funds to support badly needed new basic research. He said only 6% of the government's research expenditures go into truly basic research. Moreover, he added, although basic research funds have increased slightly, there is a need for a more balanced distribution.

Du Pont's Greenewalt, in a speech prefacing the President's, made this analogy: "We might liken our pool of basic scientific research to a savings account from which we make withdrawals as we convert that knowledge through applied research to new products and processes. As with all savings accounts, bankruptcy lies ahead when withdrawals exceed deposits." His suggestion for maintaining solvency: "Continue on the existing trend toward more and more industrial

* Symposium on Basic Research, sponsored by the National Academy of Sciences, American Assn. for the Advancement of Science, and the Alfred P. Sloan Foundation.

Merck's Tishler: Industry should emulate the research at universities.

basic research. Industrial research in this area is nothing more than a recognition by management of its responsibility to ensure corporate longevity." Note: Du Pont spent $15 million on basic research last year.

Talent Hunter: President Eisenhower said: "Fewer than 30,000 scientists (less than 0.02% of our population and only 4% of all our scientists and engineers) are engaged in basic research. Educators and scientists warn that we need to step up this effort . . . we must search out the talented individual."

But perhaps before more scientists are sought and placed on basic research projects in industry, a change in philosophy is needed. That thought was expressed by Robert Wilson, former board chairman of Standard Oil of Indiana. After the meeting, he told *CW*, "Industrial firms fundamentally geared to making profits are accustomed to demanding assurance of a return in three to five years on any investment. But they will have to change this thinking before embarking on further basic research programs."

He added, "As companies become educated (in the long-range thinking of basic research) they will realize that a proper proportion of basic research will vitalize their whole laboratory. The laggards must be made to realize they are lagging, should be stimulated to undertake more basic research."

Aid to Education: A change in the aid to education programs of both industry and government was suggested. Lee DuBridge, president of the California Institute of Technology, urged that the government (1) increase funds available for basic research, (2) pay the full cost of research it supports "in spite of contrary advice from its advisory committees," (3) increase the number of general grants for strengthening the entire area of science. He also called upon industry to expand contributions to endowment, operating and building funds.

CW's recent fellowship survey (*CW, Jan. 17, p. 62*) indicated that the CPI has already swung to an increase in unrestricted grants, at the same time decreasing the percentages of other forms of aid to education.

It's apparent that industry is getting ready to loosen the purse strings, do its part in spurring U.S. basic research.

EXPANSION

- American Cyanamid's fiber research operations previously assigned to the firm's Central Research Division have been transferred to the Fibers Division. This is in line with recent company policy to decentralize research activities.
- Carborundum Co. (Niagara Falls, N.Y.) will explore new uses for plutonium for the Atomic Energy Commission. This is reportedly the first plutonium research to be carried out in other than government laboratories.
- National Tire Dealers and Retreaders Assn. is planning a research center for Louisville, Ky., or Cincinnati, O.
- Stanford Research Institute's Southern California Laboratories has established an Agricultural Research Center in South Pasadena, Calif.
- National Starch and Chemical Corp. (New York) has installed full-scale paper finishing equipment in its Plainfield, N.J., laboratories. Plans are to use it as a primary research tool, test new coating and sizing formulations.
- Eli Lilly & Co. (Indianapolis) will dedicate its new Research Center

for Agricultural Sciences (Greenfield, Ind.) June 16. The 500-acre center will be used for investigations in the control of household and farm pests and diseases of small animals.

- Hooker Chemical Corp. (Niagara Falls, N.Y.) this week dedicated its \$3.6-million research center at Grand Island, N.Y.
- Allied Chemical Corp.'s Solvay Process Division has completed major modernization of its technical-service pulp and paper laboratory at Syracuse, N.Y.
- Armstrong Cork Co. (Lancaster, Pa.) has created a new separate department, the Textile Products Research Dept., to handle all research and development of products for the textile industry. It will be located at the firm's research center at Lancaster.
- International Nickel Co. (New York) has presented a mobile automotive laboratory to the University of Michigan College of Engineering. The unit is designed for on-the-road studies—such as exhaust gas analysis with respect to smog-producing tendencies; corrosion problems in automotive structures; carburetor and intake manifold studies. There is space and instrumentation for 18 persons aboard the restyled coach.

LITERATURE

- "Appraisal of the Safety of Chemicals in Foods, Drugs and Cosmetics" is available from The Assn. of Food and Drug Officials of the United States. It was prepared by members of the Food & Drug Administration, is available from the Texas department of health, Austin, Tex., for \$2.
- A new illustrated brochure, "Paper Chromatography and Electrophoresis Equipment," can be obtained from Research Specialties Co. (Richmond, Calif.) at no cost.
- Mann Research Laboratories (New York) has published a new list of its biochemicals for research. Included are more than 3,000 compounds used in bacteriological, nutritional, biological and microbiological laboratory work.
- The first edition of a new series of texts and monographs titled "Library Science and Documentation" is available from Interscience Publishers (New York). It's called "Tools for Machine Literature Searching," costs \$27.50.

CW PHOTO—HARRIS

Amaizo Personnel Control Supervisor Jack Krolo talks over assignments with trainees who volunteered for management jobs in unusual promotion program.

Volunteering for Top Jobs

At American Maize Products Co.'s Roby, Ind., headquarters this week 19 trainees, "survivors" of a rigorous barrage of qualification tests, are starting in a program that will fit them for supervisory responsibility. What sets these trainees apart from most, however, is that they've come from all phases of the company's operations, and all are volunteers.

The 19 are in the third group of volunteer-trainees that Amaizo has developed since 1953. This company's unusual answer to the eternal problem of finding the right people to fill management jobs is to go straight to its rank-and-file employees, ask for volunteers. Then, after sifting out the most qualified, with the help of psychological tests, it puts them through a comprehensive training program to provide them with basic management tools.

This approach, the company's industrial relations manager, Thornton Higgins, reports proudly, "knocks the old CPI problem on its ear."

Higgins says that if previous trainees can serve as a yardstick, these 19 men can look forward to a firm start with Amaizo's management after graduation day next fall. Of the 46 men who have completed other programs to date, 26 have already assumed supervisory positions in the company. And the remaining 20 represent Amaizo's pool of prime candidates for the management-level jobs that are expected to open in the near future.

No Limit: Once a man has threaded his way through the course, there are few limits to how high he can climb. Higgins points out at least four standout examples:

Arnold Grabovac, graduate of the first group in Dec. '54, has moved from a job as clerk in the industrial relations department, through a position of employment manager, to the post of the company's director of public relations.

Edward Knapp has, during the same period, stepped out of the company's reserve pool of unskilled workers, through a number of shift-foreman posts, to his present job of special assignment foreman, supervising the activities of four of the company's operating departments.

Ted Felix, hired as a chemical engineer, has moved up through an unassigned foreman's job, to the chair of chief chemical engineer.

Bill Lavely progressed from a credit union clerk, through chief payroll clerk, now has the job of shipping supervisor.

Furthermore, Amaizo places absolutely no limit on who may volunteer for a management job. Among those who have made the move are men with backgrounds ranging from an incomplete grade school education to a Ph.D. in chemistry, holding jobs ranging from unskilled laborers to research chemists and production engineers. One thing they have in common, however, is the desire to join the company's management team.

Success Ladder: To express that desire, an Amaizo employee simply must watch for his first opportunity to volunteer. Periodically, the company calls for candidates. Since '52,

Students discuss psychological exams for evaluation of supervisory qualities.

Amaizo has put out three such calls.

But not every employee dreams of joining management's ranks. Out of some 1,000 employees, only 65 answered the first call, 45 the second and 49 the third. "Many men simply don't want the responsibilities and problems of a supervisory position," Higgins explains. "Many are realistic in their self-appraisals. They realize that, whether or not they want such jobs, they just aren't equipped to handle them."

This self-appraisal is a chief ingredient in the program's success. Because of it, only the better men filter through. Says Higgins, "A man is a surprisingly honest and accurate judge of himself, and we try to take advantage of that judgment."

Amaizo puts its volunteers through two full days of detailed psychological testing designed specifically for analysis and selection of supervisors. A measure of the probing quality of these tests is the reasonably high dropout of volunteers. Of the 65 tested in the first group, 32 passed; of the 45 in the second group, only 22 made it; and of the 49 of the current group, only the 19 were passed. If a man flunks out, he can volunteer again, however.

After testing, volunteers are put through an eight-month training program, meeting once a week for two-hour lecture, conference, seminar and workshop sessions conducted by line and staff management as well as by local college instructors.

Old Systems Poor: Amaizo came up with this approach to management personnel selection after dissatisfaction with older methods. It had a continuing need for specially qualified people, found it difficult to go outside for a supervisory force. The company previously used a plan by which candidates were recommended and evaluated by committee, promoted, then tried on the job.

While this procedure produced reasonably satisfactory results, the company found that not all employees who were interested and qualified were given a chance to be considered. Also, management was disturbed by a union contract provision whereby hourly workers promoted from the ranks lost their seniority. If it turned out a man was not satisfactory, he returned to the bargaining unit as a new employee — a hard price to pay.

Furthermore, it was clear that no matter how basically qualified a man was, he needed minimum training in management techniques. It was to compensate for these three drawbacks, that Amaizo evolved the voluntary, scientifically controlled training program.

The record of the first class proved that Amaizo was on the right track; the latest class is determined to prove the plan has even more merit.

Wives Appeal in Strike

At Sarnia, Ont., 100 wives of strikers from Local 16-14 of Oil, Chemical and Atomic Workers Union, banded together to get their husbands to go back to work.

A spokesman for the wives' group, in a paid radio broadcast, urged other strikers' wives to strike themselves—against their husbands and the union. Marion Borland, chosen because of her broadcasting experience, said the strikers' "true desire is to give up this nonsense and go back to work." The synthetic rubber plant strike, more than eight weeks old, started over a demand for a 10% wage increase.

Exterminator Charged

A complaint has been filed with Georgia's secretary of state charging Getz Exterminating Co. (Atlanta) with misleading advertising. The complaint, signed by the state chemist in the Dept. of Agriculture, alleges Getz had advertised on radio that chemicals used in some of the company's operations had been approved by the U.S. government.

The state chemist expressed doubts that federal approval had been given to the chemicals, asked the state's examining board on pest control to investigate.

KEY CHANGES

J. E. Williams to corporate vice-president for manufacturing services, Olin Mathieson Chemical Corp.

Frank Coolbaugh to president, Climax Molybdenum Co., division of American Metal Climax (New York).

Charles E. Bartley to president, **Frank A. Marion** to executive vice-president, Rocket Power, Inc., new fuels-manufacturing subsidiary of Gabriel Corp. (Cleveland).

Howard D. Hartough to president, Chemical Products Division, Chemetron Corp. (Chicago).

H. H. Heltzer, R. H. Herzog, R. V. Holton, C. C. Smith, C. W. Walton, W. W. Wetzel to divisional vice-presidents of the reflective products, duplicating products, electrical products, retail trades tape, adhesives and coatings and sealers, magnetic products divisions, respectively; Minnesota Mining & Manufacturing Co. (St. Paul).

Arthur E. Thiessen, George B. Foote to directors, Baird-Atomics, Inc. (Cambridge, Mass.).

Robert G. Perriello to vice-president and general manager, Gagliardi Research Corp. (East Greenwich, R.I.).

WORLD'S FIRST "SCREECH-FREE" TIRES ARE MADE WITH ENJAY BUTYL RUBBER

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CHEMICAL WEEK
May 30, 1959

Behind Dynamics Reading Chemicals' coal-chemicals project at Pottsville, Pa., is a major switch in basic process technology. This fact was revealed by Philadelphia & Reading Corp. this week as the key to its proposed $100-million joint venture with General Dynamics Corp. (*CW, May 23, p. 21*).

Originally, P&R, with the aid of Hydrocarbon Research, set out to develop a commercial fluidized-bed technique for producing synthesis gas from anthracite silt—a mixture of coal fines, sand and rock—that contained about 70% carbon (*CW, Feb. 23, '57, p. 70*). About a year ago, however, the company switched its attention from its 50-million-ton silt reserve to anthracite refuse—coal-breaker discard containing about 25% coal, 75% rock—of which it has some 300 million tons.

Underlying Dynamics Reading Chemicals' confidence in the economic and technical feasibility of using anthracite are full-scale tests in the commercial Lurgi gasification facilities of Steinkohlengas, AG (Dorsten, Germany). Although P&R has not released cost estimates determined from these tests, comparable figures are available in a Bureau of Mines report (Report of Investigations 5420) covering similar studies conducted for the bureau at the Steinkohlengas plant.

Based on the use of anthracite at $4/ton, the bureau estimates, synthesis gas could be produced by the Lurgi process for a total material cost of about 20¢/1,000 cu. ft. DRC's material cost may be as low as 8-10¢/1,000 cu. ft., since P&R's anthracite refuse can be charged off at little or no cost (upgrading of refuse to eliminate much of the rock yields a sufficient amount of boiler-fuel-quality coal to pay for beneficiation).

Anthracite silt re-enters the picture in the companies' plans for acetylene production. Use of silt as boiler fuel will permit production of electric power at considerably below the going 8-mills rate in the Pottsville, Pa., area and less than TVA's selling price of 6 mills/kwh. Freshly mined lump coal will be used as the source of carbon for calcium carbide production. DRC's proposed acetylene capacity: "in excess of 50 million lbs./year."

P&R's optimism about the marketability of anthracite-derived chemicals is based on what it feels will be the "lowest-cost synthesis gas, hydrogen and acetylene in northeastern U.S." It foresees the Pottsville project as another Calvert City, with large-volume, over-the-fence sales to several other chemical plants in the area. Economic feasibility of translating the Lurgi gasification process to U.S. operating conditions has been guaranteed by Blaw-Knox, says P&R. And lengthy marketing studies, with the help of Arthur D. Little, Inc., have convinced the companies that they

will be able to sign up enough customers to go ahead with the project in the near future.

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New information on Sohio Chemical's acrylonitrile process (*CW Technology Newsletter, March 14; CW, Feb. 28, p. 71*) is contained in a recent Belgian patent application (571,200). The application describes a one-step method of converting a propylene-propane mixture and ammonia into acrylonitrile by catalytic air oxidation. Catalysts mentioned include phosphomolybdate and phosphotungstate salts of bismuth, antimony and tin—with preference for bismuth phosphomolybdate (made by mixing phosphoric, molybdic and nitric acids with bismuth nitrate). Catalyst is supported on silica and used as a fluidized bed. Ammonia and air are used in excess, and water is added to the reaction to increase selectivity. Temperature range is 550-1000 F; pressure, 1-3 atmospheres. Acetonitrile is produced as a by-product.

An earlier Belgian patent application (568,481) describes the production of acrolein from propylene and ammonia by essentially the same method. Key to optimizing the conversion into acrylonitrile rather than into acrolein: an ammonia-to-propylene ratio greater than 1:1.

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Research expenditures of $350 million by the National Institutes of Health are expected by '67—'59 expenditures will be an estimated $209 million. Changes are being considered in present policy to allow for payment of part of the indirect costs of supported research.

Fiscal '60 will see the initiation of four major new projects, all designed to determine the effects of automotive exhausts on health.

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A new low-temperature plastic has been developed at Union Carbide Plastics Co. (New York). Called DPD-7365, it's a copolymer of polyethylene and an unidentified material, which yields a plastic that will not become brittle at 10 F, performs well at the −10 F mark. Other properties reported include: a flex-life five times longer than that of polyethylene, high rigidity, excellent surface gloss.

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A new rubberized fabric that will withstand radiation exposures up to 100 million roentgens has been developed by Goodyear Tire & Rubber Co.'s Aviation Products Division (Akron, O.). The basic fabric used is Dacron. The special fabric was developed for a nuclear-powered blimp, capable of operating at 70-80 knots at 10,000 ft. Goodyear claims the Navy has shown interest in the project, which might give the U.S. an early, atom-powered aircraft.

Reactor shielding would be liquid synthetic rubber, with metallic boron added, which would be poured into a lead lining. Chemical fuels would be used for the engine's take-off and landing, the nuclear reactor being shut down at those times.

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CSMA Survey Results

'58 Was Better Sales Year than Expected

- **Nonfood aerosols** sold in '58 totaled 470 million units, 20% more than in '57.
- **Industrial polish** sales climbed 50%; 3.2 million gal. of water-emulsion polymer finishes were shipped; emulsion paste wax output climbed to 665,000 lbs.
- **Insecticide formulation** sales rose, too. Liquids sales went up to 10 million gal.; dry-powder sales were off slightly, to 27.9 million lbs. Sales of grain and bin sprays spurted 70%.
- **Brake fluid** sales were 10 million gal. last year, a 5.5% drop. But sales of radiator cleaners, sealers, inhibitors were all higher than last year.

Base for Optimism in '59

Plainly pointing up some significant sales gains last year, the latest surveys by the Chemical Specialties Manufacturers Assn. last week led all segments of the CSMA to take an optimistic view of '59. The cheering figures were reported at CSMA's 45th midyear get-together, which drew some 800 to Chicago's Drake Hotel.

Although the association's adjusted figures seem to point to a 20% rise in aerosol sales over '57 (390 million nonfood units), some CSMA members expressed skepticism about the accuracy of the estimate for '58 — 470 million units. Said one filler, "The industry has fallen in love with that 20%/year figure and will contort the statistics to get the estimate to turn out that way." Accurate or not, here are CSMA's aerosol findings for '58:

Hair spray accounted for about 27% of the total of 470 million nonfood units, topped the field with 100 million units. Second place was practically a four-way tie (at around 60 million units each) between room deodorants, shaving lather, insect spray and coatings.

This year's survey showed, for the first time, output of veterinarian and pet products. Production in '58 was estimated to be in excess of 3 million units.

Total number of aerosol cans produced and sold in '58, according to CSMA's survey, was 473 million, with an estimated retail value of around $500 million.

Floor Finishes: Sales of polymer and resin-type floor polishes for industrial, institutional and other commercial buildings (retail sales are not included in the survey) were nearly double the '57 totals, according to CSMA. Specifically, here were the findings on the different classes of floor cleaning and maintenance products.

Water-emulsion polymer polishes made big strides in '58. Some 3.2 million gal. were shipped, a climb of 49% over '57's output of 2.2 million gal. Also showing big gains were emulsion paste waxes. In '58, some 665,778 lbs. were turned out, compared with '57's 515,563 lbs. Biggest decline was in sweeping compounds, down 20.4% in '58, to 18.6 million lbs. from '57's 23.5 million lbs.

In the solvent-type wax field, sales of liquids were up 5.8%, to 661,392 gal., while paste waxes were down 8.4%, to 1.9 million lbs.

Floor sealers and gym finishes were gainers: in '58, the nonaqueous, oleoresinous, petroleum solvent-type product output was 2,339,345 gal., up 4.9%. Lacquer and others accounted for 94,452 gal., up 3.5%.

Liquid floor cleaners and wax strippers are broken down into six categories in the CSMA survey. The categories and the output (change from '57 in parentheses) were:

- Soaps, less than 20% nonvolatile, with or without builders: 2.3 million gal. (up 3.8%).
- Synthetics, with or without builders: 3.5 million gal. (up 15.7%).
- Soap and synthetics mixed, with or without builders: 2.6 million gal. (up 12%).
- Soaps, with 20% or more nonvolatiles, with or without builders: 1.5 million gal. (down 4.6%).
- Synthetics, with or without builders: 313,171 gal. (up 16%).
- Soap and synthetics mixed, with or without builders: 837,432 gal. (down 3.7%).

In wax emulsions (self polishing), the CSMA survey lists two categories: less than 16% nonvolatile, 8.7-million-gal. output in '58, (up 2.3%) and 16% or more nonvolatile, 2.7 million gal. (down 1.7%).

Bugs Away: Over-all sales of insecticides were up, too. Nearly 10 million gal. of liquid and 27.9 million lbs. of dry-powder insecticides were sold in '58. Sales of the liquids were up 11% over '57, while sales of the powders were down. Stored grain and bin sprays showed the biggest gain in the insecticide field, up nearly 70% last year.

Livestock sprays and emulsion concentrates accounted for the biggest share (36%) of liquid insecticides sales, with space and residual sprays for household use accounting for 275,000 and 341,000 gal., respectively. Among dry-powder sales, products for use on livestock accounted for 2.6 million lbs.; powder insecticides for other than livestock use, 21.6 million lbs.; fly bait, about 2.6 million lbs.

Other insecticide sales last year: personal insect repellents, 3.3 million packages; vaporizer chemicals, 8,820

packages; small-pet insecticides, 645,000 packages of dry products and 30,000 packages of liquid types of insecticides.

Brake Fluid Survey: Slightly less than 10 million gal. of brake fluid were produced by U. S. manufacturers in '58. This represents about a 5.5% reduction in '58 production, versus '57's, when production was 10.5 million gal.

At the same time, output of cleaners for use in automobile cooling systems were up, however. Slightly over 4.6 million single-treatment packages of the cooling-system cleaners were manufactured for use in the nation's motor vehicles in '58. The actual total of 4.6 million consumer-size packages of chemicals was 580,035 units greater than in '57.

The '58 figure for production of cooling-system sealers totaled 12,430,863 units, compared with 11,683,159 in '57.

Output of combination water-pump lubricants and rust inhibitors in '58 amounted to 9.1 million single-treatment packages, compared with 7.3 million units in '57.

Cooling-system inhibitors designed to combat rust formation also were included in the association's survey, but the report showed only '58 production of dry types—a total of 442,240 units.

Predictions, Too: All glances were not backward ones, however. Arthur Connolly of Simoniz Co. (Chicago) spoke of the coming obsolescence in the next decade of some automotive chemical specialties:

Automotive chassis requiring no grease lubrication, he says, definitely will be installed on at least two 1960-model cars. In two or three years after that, nearly every new car will have a lube-free chassis.

Closed cooling systems, he figures, would eliminate the need for antifreeze and radiator chemicals. Turbine engines, when they come, would be air cooled and would require no antifreeze or radiator chemicals.

Also, the gas turbine engine, which Connolly apparently sees as the coming thing, would eliminate the need for automatic transmissions and therefore the need for automotive transmission fluids.

CSMA's next meeting is scheduled for New York, next November 26-27, at the Hotel Roosevelt.

Waxer's Rebuttal

A spokesman for S. C. Johnson last week ripped into the claims of auto makers that their new auto finishes don't need waxing.

J. V. Steinle, research and development vice-president of Johnson's Wax, said that despite the car makers' claims, three years of testing prove there is a definite need for cleaning, polishing and waxing new car surfaces.

Further, Steinle said, there is a "significant difference" between what is said in the manufacturers' advertisements and what is recommended in the manuals provided with their new cars. He pointed out that both Ford and Chevrolet suggest in the owners' booklets that the cars be cleaned with prewax compounds, then waxed, if full luster of the finish is to be preserved.

All three of the major auto makers have been making the "no-wax" claims. General Motors apparently started it, with introduction of its new acrylic lacquer finishes; Chrysler and Ford, with melamine-modified paints (which Steinle acknowledges all are improved finishes), have taken up the cry. So far, the car companies have not specifically answered the Johnson contentions.

Driller's Specialties

Makers of oil drilling specialties were on hand at the giant International Petroleum Exposition (CW, May 9, p. 44) that closed in Tulsa, Okla., last week.

The show, which drew an estimated 500,000 visitors, featured displays that included:

- Magnet Cove Barium Corp.'s (Houston) new drilling fluid component, HS-400, designed to work in wells where temperatures up to 460 F are encountered.

Magcobar also showed off a new bit lube, an extreme-pressure lubricant for drilling muds, and a surfactant formulation designed to remove formation blocks.

- U.S. Borax and Chemical Corp.'s (New York) boron-containing specialties that might have oil field application—hand cleaners, weed killers, oil well cements.
- Oakite Products, Inc.'s (New York) Recta S-A stripper—originally designed to remove paints. It was

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offered to drillers for stripping resins from reinforced-glass-fiber equipment and pipes. The stripper is claimed to remove epoxies, acrylics, vinyls, and polyesters.

• Dowell Division of Dow Chemical Co.'s corrosion testing wheel. It is designed to find which type of inhibitor the driller needs to add to his drilling fluids. The wheel has 16 glass pressure vessels, which are filled with samples from the well, and a steel test panel; a different inhibitor can be added to each bottle. Sixteen to 24 hours of rotation will generally indicate the best inhibitor.

Filler for Rent

Taking advantage of the specialties makers' meeting in Chicago, Mojonnier Associates (Chicago) last week showed off its new plan to rent aerosol filling equipment. Typical: complete manual filler for lab work, renting for $55/month.

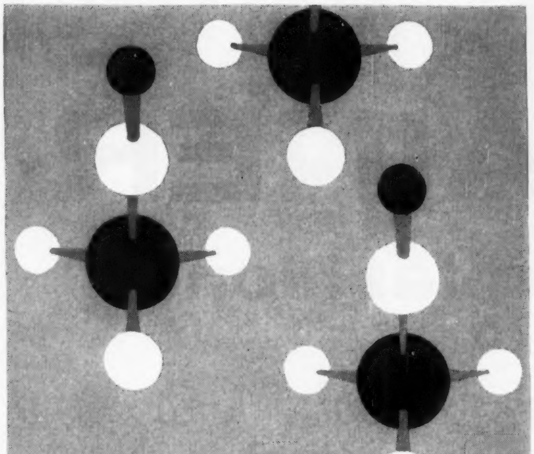
Several rent plans are available. The $55/month setup includes two hand-operated table-top machines—a valve crimper and can sealer—and a nitrogen gasser to charge the can. For an additional $35/month, Mojonnier will supply a bottle crimper; a charger designed for fluorinated hydrocarbons can be obtained for $65.

The units for the new plan were first shown at the National Packaging Exposition in Chicago last month, but the rental plan is just now being introduced. It's said to be the industry's first.

The company has frankly devised the plan to stimulate equipment sales—rental fees may at any time be applied to the equipment's purchase price. With its novel renting idea, Mojonnier spokesmen say, the firm hopes to double its sales prospects.

Computer Buyer

First specialties maker to install a Univac Solid-State Computer will be Economics Laboratory, Inc. (St. Paul), maker of detergents for both consumer and industrial uses. It will get the complex unit this summer, will use it for invoicing, inventory control, auxiliary accounting reports, and statistical applications. Remington Rand makes the computer, which will be installed in Economics Laboratory's St. Paul office.



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Formula $NaOCH_3$	Formula Weight 54.03

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Sodium Carbonate	0.4
Sodium Formate	0.3
Methanol (Free)	0.5

Soluble in Alcohols, Fats, and Esters
Decomposed violently by water
Standard 95.0% min.

PHYSICAL PROPERTIES

Fine white powder—over 75% through 150 mesh—less than 1% on 10 mesh

Melting Point: none . . . decomposes in air above 260°F.

Harshaw Sodium Methylate Liquid

(Spec. 102)

Packaged in Steel Drums . . . . 425 pounds net
25% solution of sodium methylate in methanol

Analysis:

Sodium Methylate Content . . 25% minimum

Physical Properties: slightly cloudy to clear solution

Bulking Density	about 7 lbs. per gallon
Initial Boiling Point	188°F for 25%
Flash Point (Cleveland Open Cup)	85-90°F
Flash Point (Closed Cup)	80°F
Crystallization Temp.	30°F after equilibrium

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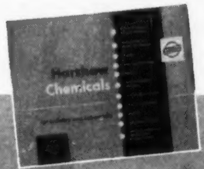

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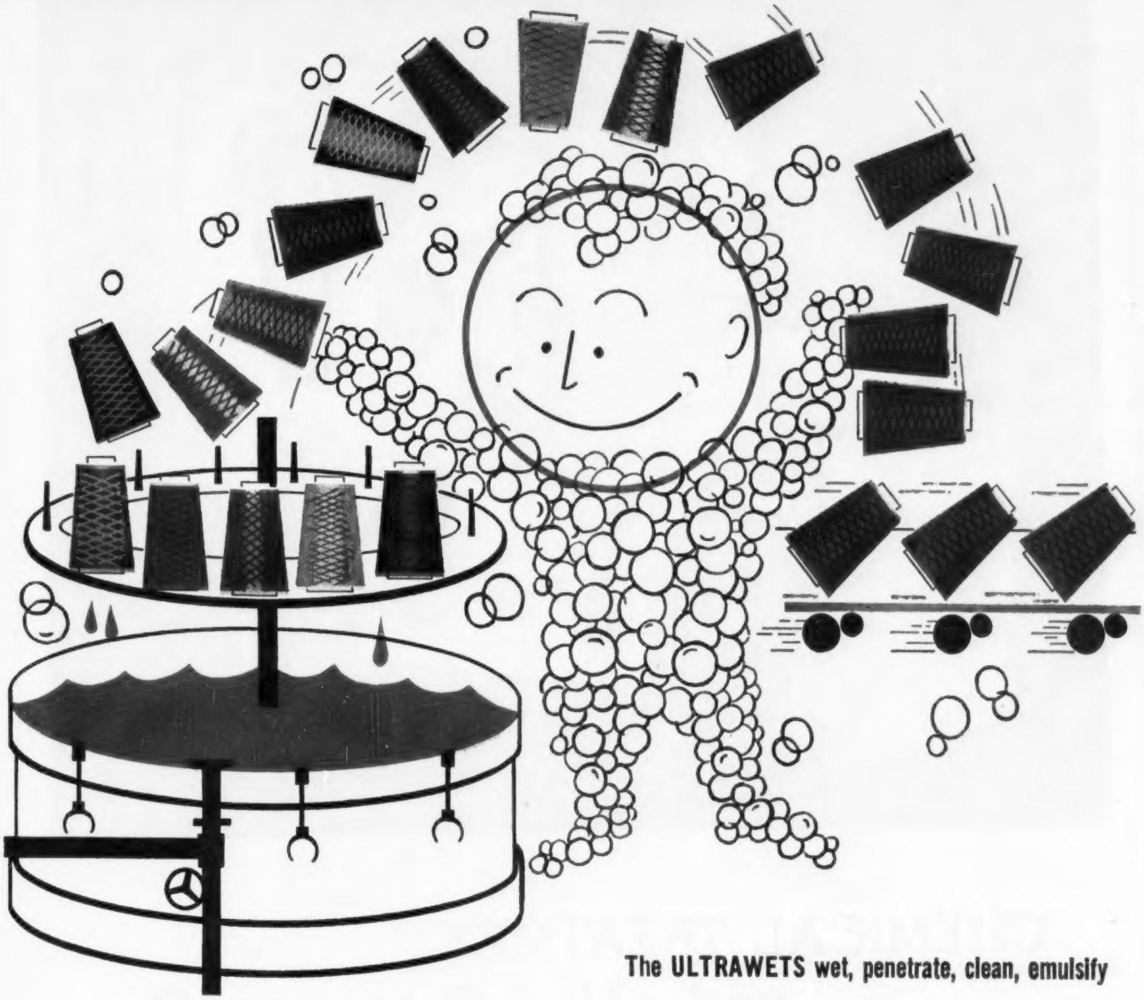

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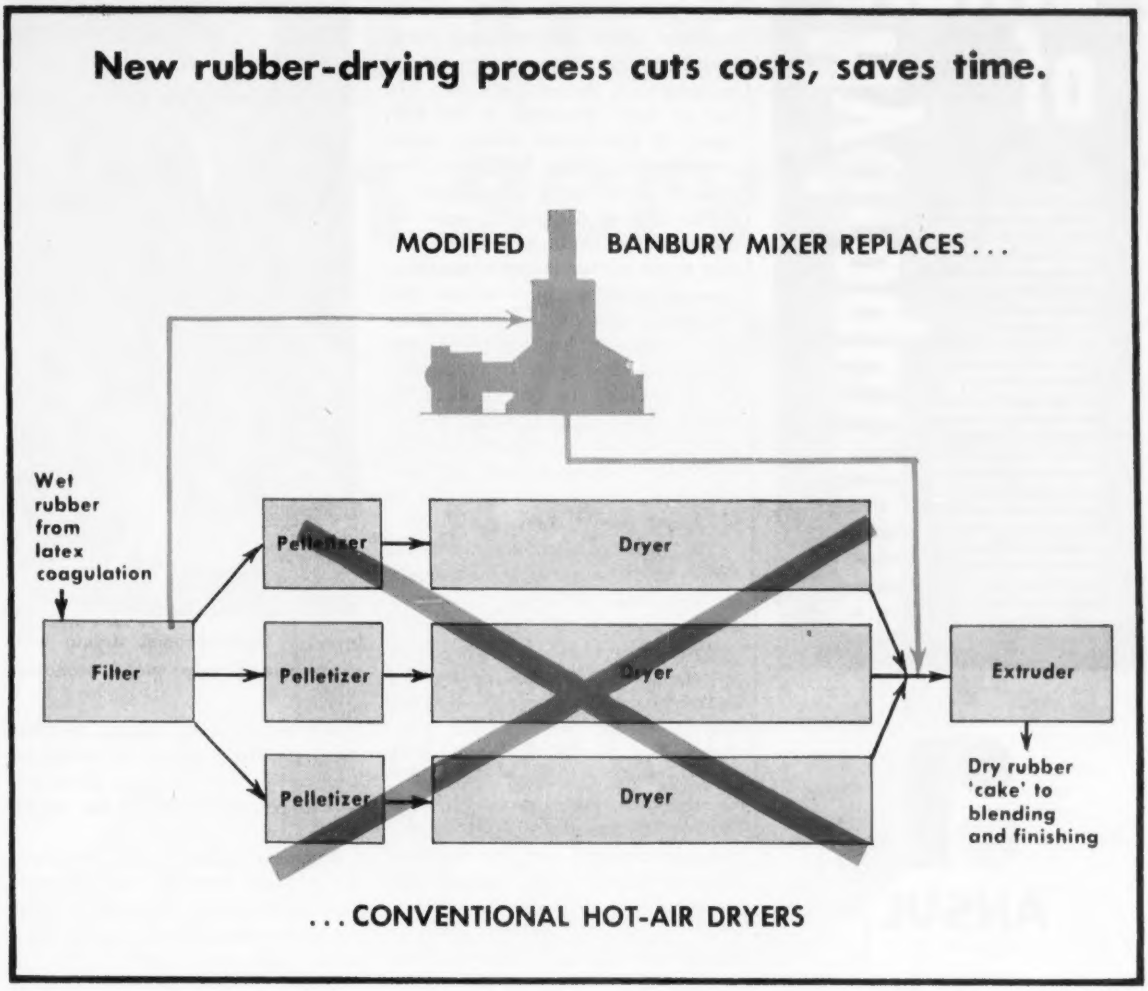


Mixer Takes Extra Role as Rubber Dryer

A new rubber-processing technique made available for licensing last week by The Patent and Licensing Corp. (New York) opens a shortcut to faster, more economical dewatering of natural and synthetic rubbers. As diagramed above, the key is a patented mixing procedure (U.S. 2,854,426) using a modified Banbury mixer to heat the wet rubber by mechanical action.

The new process (*CW Technology Newsletter, May 23*) boasts several advantages that are expected to bolster its move into competition with conventional drying systems. Its most impressive claim: substantially lower operating cost — estimated to be $5-10/ton below that of hot-air drying systems in common use. This saving, says P&L, is largely attributable to the speed of the Banbury drying operation, which minimizes the capital investment required for a given throughput. A single modified Banbury, costing about $250,000, can handle three times as much rubber as a comparably priced tunnel dryer.

The short drying time — one to three minutes for a 400-lb. batch in a No. 11 Banbury — also prevents deterioration of rubber, such as that caused by oxidation during long exposure to heated drying air. The new process, says P&L, can also handle latex "fines" that can't be dried in conventional equipment, and for processing scrap normally discarded from coagulation equipment.

Growth of a Concept: The new drying technique was developed by Paul Dasher and has been used commercially over the past five years for custom-rubber processing at his Dasher Rubber & Chemical Co. (Fairport Harbor, O.). Throughout the development, Dasher cooperated closely with Farrel-Birmingham Co., Inc. (Ansonia, Conn.), manufacturer of Banbury equipment. P&L, a wholly owned subsidiary of The Flintkote Co. (New York), holds earlier Banbury process patents, is the exclusive licensing agent for Dasher's

mechanical rubber-dewatering process.

The drying application evolved from Dasher's earlier work with the Banbury mixer for reducing scrap vulcanized rubber to finely divided particles (U.S. Patent 2,853,742). The key to both operations is the high input of mechanical energy, which generates heat within the rubber mass through shear stress and friction.

The idea of flashing off water by mechanical action under pressure isn't new to the rubber industry; modifications of screw machines of the type commonly used for extruding rubber have reportedly been employed for dewatering by several processors. Goodrich-Gulf, for one, worked on such a system at its Institute, W.Va., plant; similar compression-drying equipment has been used by U.S. Rubber at Naugatuck, Conn., and by Phillips at Borger, Tex.

The modified Banbury, however, affords several advantages, says Dasher, that make it easier to operate and maintain. Here's how it works:

Synthetic rubber from the latex coagulation system is filtered and delivered to the drying stage as a wet mixture (about 60% solids, 40% water). As each 400-lb. batch is fed into the Banbury mixer, about half the water is squeezed out by the 150-200-psi. pressure exerted by the hydraulic charging ram. (In the conventional drying system, the pelletizer ahead of the tunnel dryer serves a similar purpose.) Suitable valving to permit removal of this water from the charging throat is one of the modifications required to adapt the mixer to drying use.

High shearing forces are created within the mass of wet rubber by the mixing rotors driven at 50-100 rpm. An extra-heavy motor and gear-drive system supplies an energy input of about 3 hp./pound of dry rubber — sufficient to heat the mass to 250-300 F in less than one minute. Water in the rubber flashes off as steam, which escapes through clearances between the hydraulic ram and the charging throat of the mixer. (In the screw machine, says Dasher, tolerances are closer, trapped steam can produce sufficient back-pressure to interfere with the operation.)

Drying to a final water content of less than 1% (generally to about 0.5%) is completed in one to two minutes, after which fast-acting doors

Inventor Dasher teams drying with mixing operation for speed, economy.

at the bottom of the mixing chamber dump the batch before it overheats. Additives — carbon black, clays, oils — can be put in during the drying step.

Processors generally use two stages of additives blending, says Dasher. They would likely eliminate the first one by combining it with the Banbury drying cycle. Dried rubber from the Banbury is pelletized for uniform cooling, then extruded and finished by conventional methods.

Preserving Quality: A primary consideration in rubber processing is the degrading effect of prolonged exposure to heat. The total heat history of a batch largely determines what you can eventually do with the rubber, says Dasher. By limiting its exposure to high temperatures, the new Banbury drying method preserves the strength, Mooney value and other desirable physical properties.

Exposure to heat is even more critical in the case of heat-sensitive rubbers, such as acrylonitrile types, that conventionally require vacuum drying. In competition with vacuum dryers, says P&L, the Banbury dryer will provide savings substantially higher than the $5-10/ton figure.

Market Outlook: Although P&L is

optimistic about the new process's chances of commercial success, it doesn't expect rubber processors to scrap existing drying equipment and switch to the shortcut method. But it's confident that the Banbury dryer will take over a sizable share of the rubber industry's drying operations within the next five years — most likely as replacement equipment.

Strictly on the basis of capital investment, says P&L, the Banbury has a strong competitive edge. A $250,000 Banbury can handle 6,000 lbs./hour of dry rubber and — unlike conventional tunnel dryers, which require periodic shutdowns — can operate continuously. Aside from normal maintenance and occasional relining (mixing compartment linings last two to three years), a Banbury can be expected to last 10 years—or, in terms of throughput, for 250,000 tons of dry rubber.

Two other factors in the Banbury's favor: it's a familiar piece of equipment in rubber-processing plants; its claimed advantages for drying applications are backed up by more than five years of actual commercial use by Dasher Rubber & Chemical.

Rubber processors' interest in the method is indicated by the large amount of test work that has been performed in Farrel-Birmingham's test laboratory. To date, F-B has test-dried rubber for all but two of the major rubber companies, says it will soon conduct a test run on a whole week's production for one firm.

P&L disclosed that "one major rubber manufacturer" is currently using the new process on a commercial basis. Although the company wouldn't comment further on details of this operation, nor on the status of licensing arrangements with the unnamed company, trade observers say the method is being used by General Tire & Rubber Co. at Odessa, Tex. General's only comment: it knows about the process and is "following its development closely."

Licensing and royalty provisions haven't been completed, says P&L, but will be tied to savings in operating costs. In the case of common synthetic rubbers, royalties will likely be about $1/ton of dry rubber. In the case of heat-sensitive types, the charges will probably be higher — based on proportionately greater savings over vacuum-drying methods.

MAJOR U.S. OXYGEN EXPANSIONS

(Scheduled for completion in '59 and '60)

AIR PRODUCTS PLANTS:

To Supply:	*Location:*	*Capacity:* (cu.ft./month)	*Due Onstream:*
Acme Steel	Chicago	100 million	May '59
Air Products	Glassmere, Pa.	($6 million)	Fall '59
Du Pont	New Johnsonville, Tenn.	60 million	May '59
U.S. Steel	Clairton, Pa.	22 million	May '59

AIR REDUCTION PLANTS:

To Supply:	*Location:*	*Capacity:* tons/day	*Due Onstream:*
Air Reduction	Baton Rouge, La.	18*	'59
Air Reduction	Birmingham, Ala.	18*	'59
Air Reduction	Richmond, Calif.	22*	Oct. '59
Armco Steel	Butler, Pa.	120	Early '60
"A steel company"	Not revealed	120	Not revealed

** Approximate oxygen capacities. Total oxygen, nitrogen and argon capacities are 30 tons/day at Richmond, 25 tons/day at other two sites.

LINDE CO. PLANTS:

To Supply:	*Location:*	*Capacity:* (cu.ft./month)	*Due Onstream:*
Armco Steel	Middletown, O.	80 million	Aug. '59
Great Lakes Steel	Ecorse, Mich.	(500 tons/day)	Mid-'60
Linde	Huntsville, Ala.	(135 tons/day)†	July '60
Linde	Pittsburg, Calif.	(165 tons/day)† (135 tons/day)†	May '59 Oct. '59
Lukens Steel	Coatesville, Pa.	80 million	May '59
U.S. Steel	Gary, Ind.	94 million	Feb. '60
U.S. Steel	Fairless, Pa.	100 million	'60
U.S. Steel	Duquesne, Pa.	(1,000 tons/day)	'60
Mobay Chemical	New Martinsville, W. Va.	20 million†	Jan. '60

† Capacity includes nitrogen as well as oxygen.

Steel Strengthens Oxygen Roster

Like marketing men in other segments of the CPI, U.S. oxygen producers have their eye on the steel industry. But they are looking beyond a possible summer steel strike. For, as the chart on p. 89 makes clear, oxygen's growth in the next two years will reflect steelmaking requirements.

Most of the oxygen output (both high and low purities) of 79 firms that operate about 300 plants (according to government listings) goes into steel production. And it's certain that steel uses will be the main bulwark of oxygen sales for a long time: not only are more steel producers turning to oxygen processes; where the gas is already in use, consumption/ton of steel produced is increasing steadily.

CW's listing of new oxygen plants to be built before '61 is necessarily incomplete. Other plants by major builders are also on the drawing boards — or soon will be — but producer-buyer negotiations in many cases are not yet ripe for public disclosure.

Projects of smaller firms also will add substantial capacity to the na-

tional total, but these plans are seldom revealed.

Among important expansions, however, are these:

National Cylinder Gas (division of Chemetron) will soon complete a \$3-million oxygen unit near Philadelphia. This installation will supply oxygen mainly to Allan Wood Steel, has a rated capacity of 65 tons/day of oxygen, nitrogen, argon (estimate: about 48 tons/day of oxygen). NCG recently put another 28-tons/day oxygen unit onstream at its Los Angeles facilities.

American Oxygen Service is putting up a 25-tons/day unit at Harrison, N.J., expects to complete it this summer.

Meanwhile, missile manufacturers and other industries on the West Coast have started receiving liquid oxygen from Linde's new plant at Pittsburg, Calif. The first shipment left the plant via trailer truck, May 14, almost one month ahead of scheduled time.

According to W. M. Haille, Linde's president, completion of the plant was speeded up to relieve what might have become a critical shortage of liquid oxygen and nitrogen in the area.

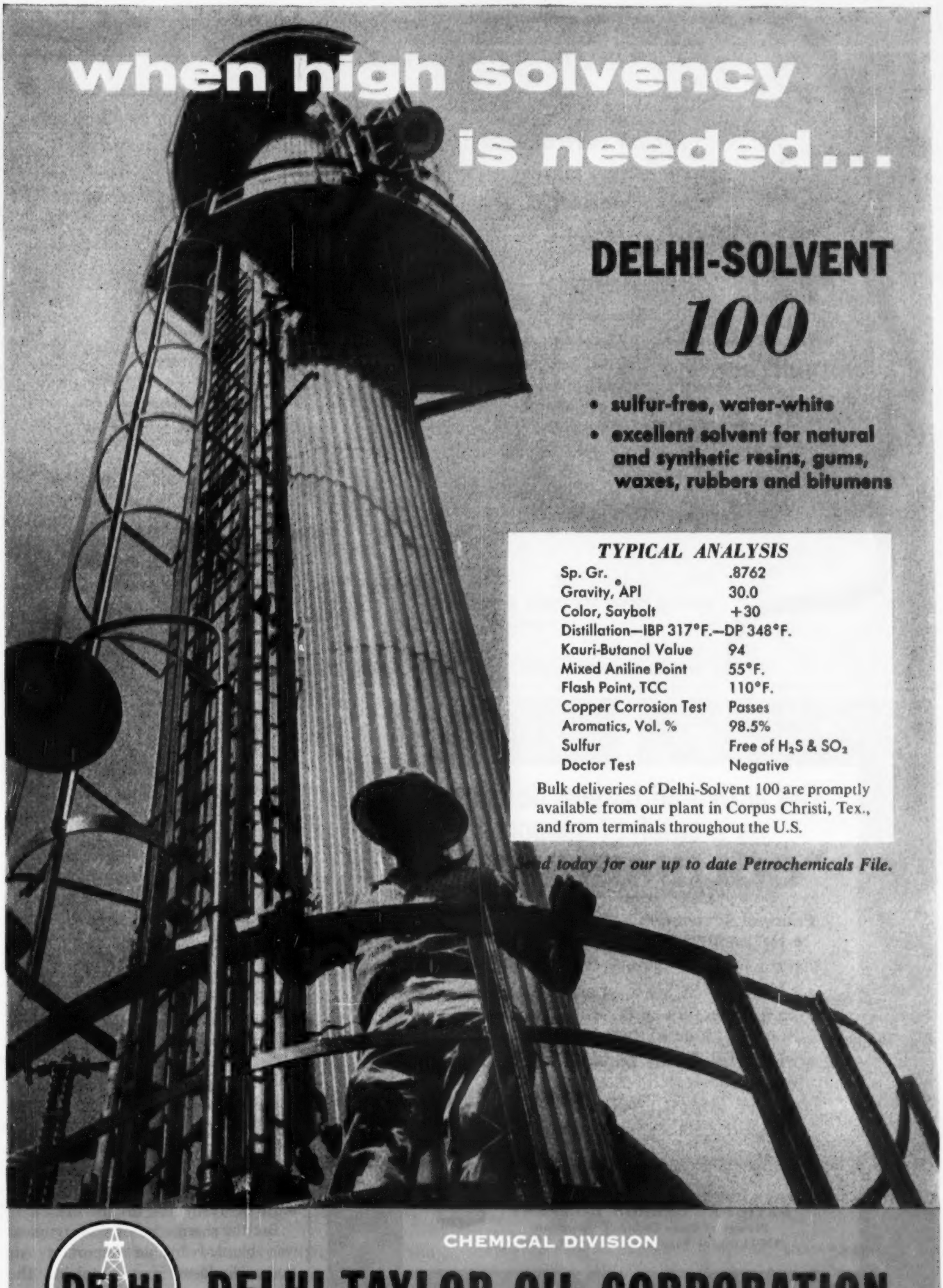
This material came from the plant's first unit (165-tons/day capacity). The remainder of the construction work will be completed about the latter part of October. This additional equipment will raise capacity to about 300 tons/day (including liquid oxygen and nitrogen).

The plant, which will be the largest of its kind in the West, has two spherical tanks, 50 ft. in diameter, each capable of holding 25 million cu. ft. of liquid oxygen or nitrogen.

In the East, Linde will also construct a liquid oxygen-liquid nitrogen plant at Huntsville, Ala. The plant will be built near the Army's Ballistic Missile Test Center at Redstone Arsenal. Rated capacity will be about 135 tons/day. Completion is expected around the first half of '60.

High-Purity Push: Oxygen end-use breakdowns frequently lump demands for both high-purity and so-called "tonnage" or "low purity" gases; but, since the two grades of gas have essentially different markets, a case can be made for separate treatment.

Tonnage oxygen goes into two major uses. About 50% is used in chem-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Estimated '59 High-Purity Oxygen Demand

	Billion cubic feet	Percent of total
Steel	33	60
Missiles	8.25	15
Metal fabrication (welding, cutting)	6.60	12
Chemical	5.50	10
Breathing, (medical, aircraft, etc)	1.65	3
	55.0*	100%

*Includes an estimated 5 billion cu. ft. of government-produced oxygen.

ical applications (the gas is made in captive plants and piped to place of use), and the other half goes into steel production. About 25 billion cu.-ft. of lower-purity oxygen were produced in '58; an estimated 30 billion will be turned out this year.

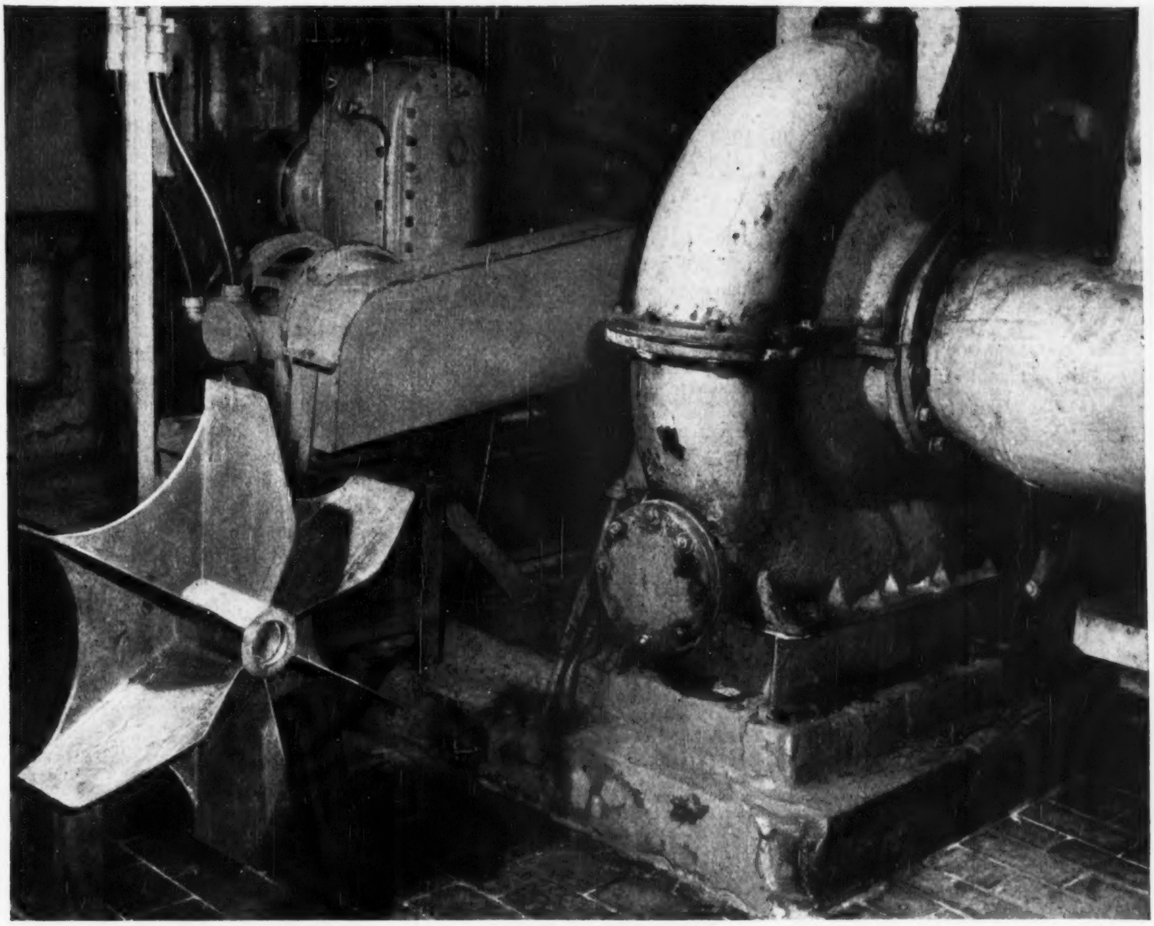
Greatest interest in the trade centers on high-purity oxygen (*see breakdown, p. 92*).

Chemical uses make up about 10% of total demand for high-purity material (about 5.5 billion cu.ft. in '59); biggest use is for partial oxidation processes used to make hydrogen, carbon monoxide, acetylene, ethylene. These uses are expected to increase substantially.

Missile Muddle Brightens: Enormous amounts of oxygen are used currently in missile testing programs — one industry estimate puts consumption at more than 1,200 tons/-day. But it's a fluctuating market; during periods of peak activity in missile work, federal installations are unable to produce enough oxygen, and private producers are asked to supply additional amounts.

Over the long range, say proponents of solid fuels, liquid systems (e.g., based on oxygen) can't continue to compete effectively. Reason: low-temperature liquids are too difficult to store permanently in missiles, which must be ready for instant use.

But the sharp edge of this argument was blunted by an important Air Force disclosure last fortnight. The Air Force reported that a hydrogen-oxygen combination gave 40% more thrust than is obtained with currently used combinations of fuels (*CW Tech-*



The impeller you see has been a spare for 10 years! Both it and the working impeller inside the housing at right are Illium "G", a 56% nickel alloy particularly resistant to the SO_2 gases handled by the blower. The blower is installed at the Crown-Zellerbach Corporation plant in Camas, Washington.

Spare nickel alloy impeller for SO_2 sits unused for 10 years!

...working impeller's still good for years to come

SO_2 gases are mighty hard on most impeller metals. *Yet, the spare impeller you see has not been needed since the blower went in over 10 years ago!* Blower exhausts 17% SO_2 gases at 90°F from pulp mill sulfur burners.

Both impellers are Illium "G"*, a high-nickel alloy cast by Stainless Foundry and Engineering, Inc., Milwaukee, Wisconsin. This high-nickel alloy provides superior resistance to the corrosive attack of many strong acids (particularly sulfur compounds), caustics, oxidizing and reducing agents, and sea water. It's readily welded and machined, too.

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May 30, 1959

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nology Newsletter, May 16).

This fact, coupled with guarded hints by some oxygen producers that it's now feasible to store liquid oxygen in missiles for long periods of time, brightens the future for oxygen.

Lower Cost Coming? Much debated is the possibility that oxygen prices can eventually be brought down to the $4-5/ton level, but there's increasing doubt among the experts that this will be possible.

Just last week, for example, Ernest Nachod of Air Products told the Chemical Market Research Assn. (meeting in New York) that oxygen in large quantities won't be available for less than $6-8/ton.

Cost of producing oxygen, he noted, will be divided about equally between capital charges, operating costs, power costs; the over-all cost will vary somewhat on size of installation and cost of power, but the $6 to $8/ton figure, Nachod said, will be fairly accurate for plants turning out 300 or more tons/day.

Capital charges are expected to rise (except where mechanical equipment, e.g., compressors, can be improved). Operating costs will no doubt increase. Power costs, however, can be decreased through mechanical improvements, but the rock-bottom power consumption for oxygen production, where oxygen is delivered essentially at atmospheric pressure is about 330-340 kilowatt hours/ton.

Based on 6-mil power, reasons Nachod, this means the power cost will approximate $2/ton and puts over-all cost of oxygen at about $6/ton — not including a satisfactory return for the producing company.

In any case, current trends in consumption of oxygen in steelmaking—and the tremendous potential for its use in missiles — assure oxygen producers of rapidly growing markets.

Steel will be the focal point in the future expanding market for oxygen. Consumption of oxygen in the U.S. steel industry has, according to the experts, mounted steadily during the past decade to a record demand of 26 billion cu. ft./year—which represents more than 230 cu. ft./ton steel. (This compares with 200 cu. ft. used in '56, and only 100 cu. ft./ton of steel made a decade ago.)

It has resulted from increased use of injected oxygen for carbon reduction in refining open hearth and elec-

tric furnaces; use in production of improved stainless steels; top-blown basic oxygen process and enrichment of blast furnace air; flame enrichment during melt-down in open hearth processes. The technological changes that have given oxygen its impressive record in steelmaking will continue, use per ton of steel is expected to increase to over 300 cu. ft./ton in the foreseeable future.

As Nachod points out, total U.S. oxygen production is increasing at the rate of approximately 12% annually. It means that the industry is spending about $20 million/year for construction of oxygen-producing facilities.

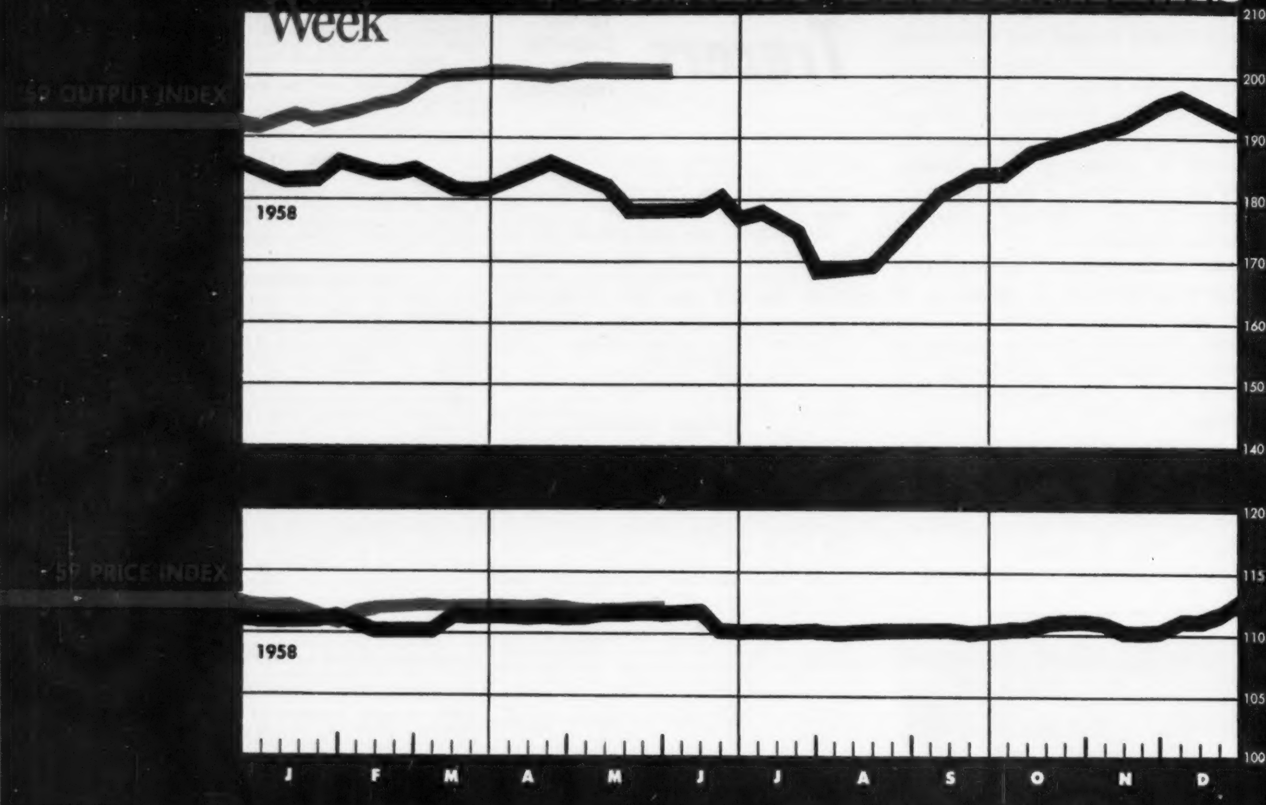
Nachod's conclusion: production will increase at approximately the same rate—i.e., 12%/year— for the next few years and, perhaps, will accelerate with increasing interest in use of oxygen for chemical processing.

New Bag for Old Bones

A polyethylene-draped dinosaur—covered during cleaning and renovating operations at the Carnegie Museum in Pittsburgh—points up the diversity of plastic film uses that have helped spur a rash of new plans for polyethylene output expansions (*CW, May 9, p. 40*).

Nearly 12,000 sq. ft. of Koppers Durethene polyethylene film was needed to cover the 77-ft.-long, 150-million-years-old apatosaurus skeleton. PE replaced heavier coverings because it is less likely to dislodge delicately balanced bones.

BUSINESS BENCHMARKS

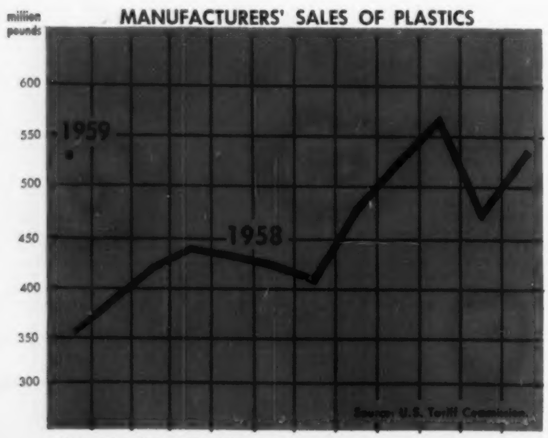


MAY 30, 1959

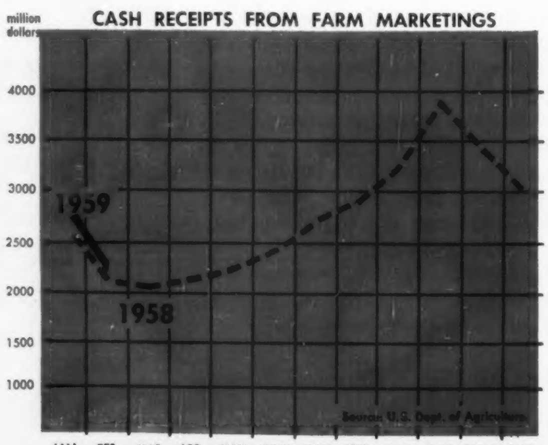
WEEKLY BUSINESS INDICATORS	Latest Week	Preceding Week	Year Ago
Chemical Week output index (1947-1949=100)	201.3	201.7	180.0
Chemical Week wholesale price index (1947=100)	112.4	112.4	111.0
Stock price index (11 firms, Standard & Poor's)	58.48	59.29	38.66
Steel ingot output (thousand tons)	2,674	2,631	1,523
Electric power (million kilowatt-hours)	12,684	12,659	11,257
Crude oil and condensate (daily av., thousand bbls.)	7,178	7,225	6,262

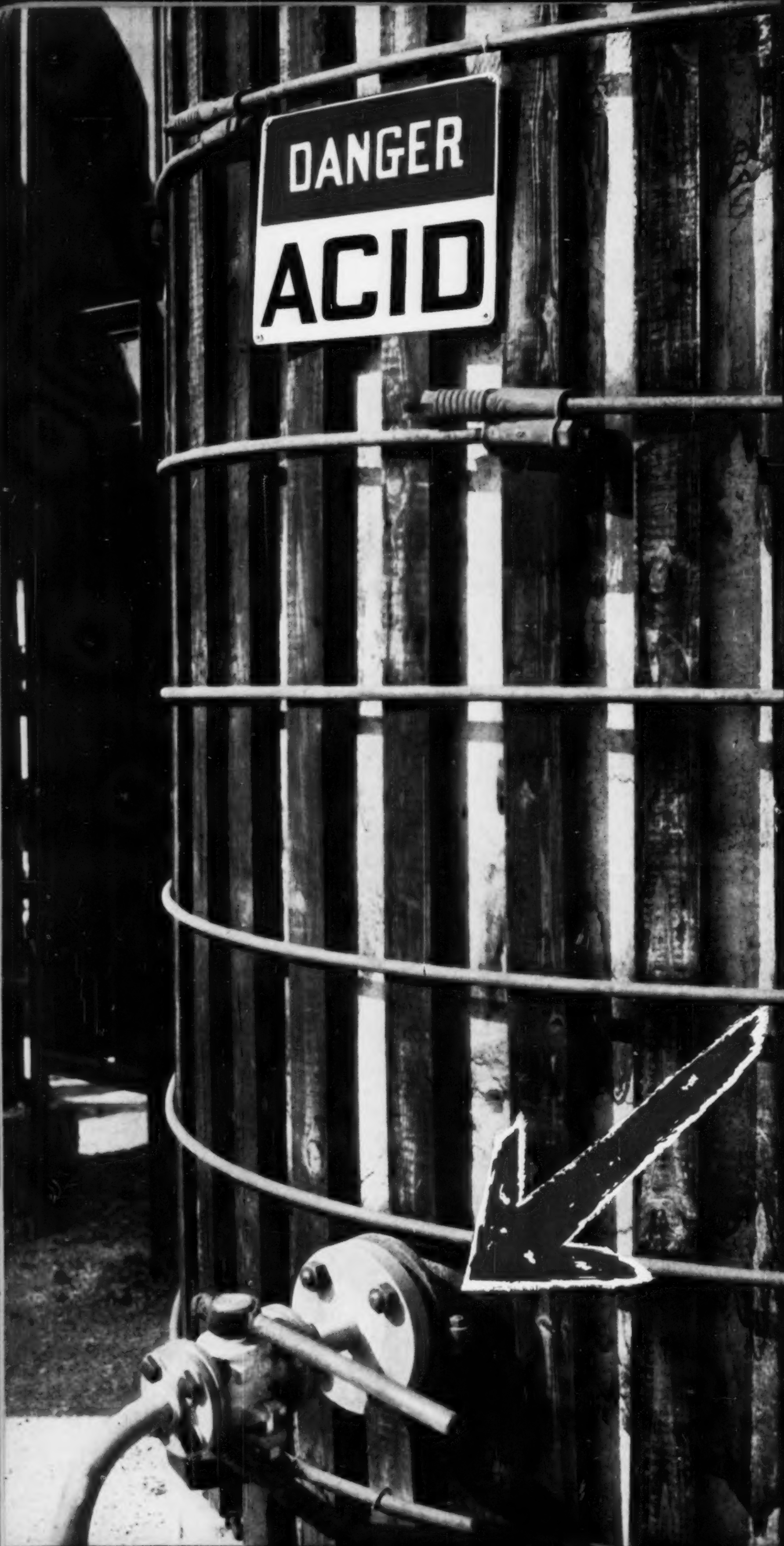
MONTHLY INDICATORS—Employment (thousands)	Latest Month	Preceding Month	Year Ago
All manufacturing	12,130	12,114	11,310
Nondurable goods	5,140	5,180	4,973
Chemicals and allied products	533.5	527.7	519.3
Paper and allied products	443.5	442.3	434.2
Rubber products	186.2	202.0	176.0
Petroleum and coal products	154.6	154.8	156.7

MANUFACTURERS' SALES OF PLASTICS



CASH RECEIPTS FROM FARM MARKETINGS

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